THE TELEGRAPHIC JOURNAL AND

Electrical Review.

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THE SURVEYOR OF CHELSEA ON THE ELECTRIC LIGHT.

We were favoured last week with a copy of the report on electric lighting made by Mr. Stayton, C.E., the surveyor to the Chelsea Vestry. We could not at the moment deal with the matter as it deserved, and therefore preferred to leave it over until a more favourable opportunity presented itself of dealing with the subject. Mr. Stayton, in the course of his duties, entered very fully into the question of electric lighting, and the results of his relations with various electric light companies respecting the lighting of Chelsea by means of electricity are very instructive and will show just to what extent such companies are prepared to act. Mr. Stayton commences with an analysis of the Electric Lighting Act, but upon this point we need not dilate.

It appears that the applications received by the Vestry for consent to the granting of a licence by the Board of Trade were from :—

The Metropolitan Brush Electric Light and Power Company.

The Jablochkoff Electric Light and Power Company.

Notices of intention to apply to the Board of Trade for a provisional order were also served upon the Vestry on behalf of :—

The Metropolitan Brush Electric Light and Power Company.

The Edison Electric Light Company.

The Swan United Electric Light Company.

The "Pilsen"-Joel and General Electric Light Company.

The Gülcher Electric Light and Power Generator Company.

The West Middlesex Electric Light Company.

Messrs. Ferranti, Thompson, and Ince (Limited).

The Surveyor thinks that local authorities must look to the Board of Trade in a great measure for protection against the inconveniences which may arise in consequence of their hands being forced, as it were, by the action of certain speculative companies, who have indiscriminately given notice of application for licences and provisional orders, not only in the metropolis but throughout the country.

Mr. Stayton was apparently determined upon making a thorough investigation into the pretensions of the electric light companies, and he therefore sought particulars on some of the principal points upon which definite information was required :

(*a*) The terms on which a company would contract with the vestry under Section 11 of the Act.

(*b*) The area or areas of supply.

(*c*) The regulations for breaking up streets.

(*d*) A description and cost of the works.

(*e*) The amount of capital required.

(*f*) The probable cost of street lighting as compared with gas.

(*g*) The scale of charges for supply of electricity.

(*h*) The mode of measurement for all purposes and description of electric meter.

(*i*) The provision for accumulators or secondary batteries, or other means for steadiness, regularity, and amount of supply.

(*j*) The provisions for public safety and danger to property.

With a view to obtaining this information the surveyor communicated with the various companies mentioned, and subsequently with Messrs. Siemens Bros. We may add here that the parish contains about forty miles of streets and 12,000 houses, and that the existing street lighting is effected by means of 1,250 gas-lamps at a cost of £4,500 per annum, gas being supplied at three shillings per thousand cubic feet.

Concerning the information required (*a*) to (*j*), Mr. Stayton tabulated a series of twenty questions for the companies to consider and answer. Our space is too limited to allow of publishing these questions in our columns, although we would otherwise be glad to do so, in order that our readers might judge of the uncertainty and want of harmony in the answers given. We can, however, give some of the more important.

QUESTIONS.	METROPOLITAN (BRUSH).	EDISON.	JABLOCHKOFF.	SWAN.	FERRANTI, THOMPSON, AND INCE.	"PILSEN"-JOEL.	SIEMENS BROTHERS AND Co.
AS TO LICENCE.							
1. In the event of the vestry obtaining a licence, would your company be willing to contract with them, as provided by the 11th section of the Act?	Yes.	A company to work the Edison patents in the South Western district is in process of formation, and the carrying out of any installations in the Chelsea district would devolve upon them.	Yes.	Not answered.	This company are anxious to see all the vestries apply for provisional orders, and in the event of their so doing, desire to contract as proposed under the 11th section of the Act.	Not at present, but the company would be glad to help the vestry by supplying the apparatus required on the best possible terms.	Our company intend to remain as much as possible manufacturers, we would therefore not be inclined to undertake the contract of lighting any district.
10. What is the probable size of the electric conductors, and mode of laying same?	About ½ to ¾ inch diameter, and laid in cast iron pipes, which are buried two feet below the road surface. In order to lay these pipes a trench two feet deep, and about one and three-quarters wide, has to be dug.	The size varies according to the number of lamps it is intended to supply, and their distance from the generating or central station.	The conductor used for the "Jablochkoff" light is 7 strand, 16 B. g. properly insulated; this will distribute the light over an area of 20 miles' circumference.	The main conductors will be laid in cast-iron troughs, about 6 in. by 10 in. underneath the flagging of the footway and near to the kerb. In some cases it will be found convenient to lay them in two cast-iron pipes, about 4½ in. external diameter each.	Dependent on the length of mains and number of lights.	About ⅛ inch in diameter, to be laid in wooden troughs.	The size depends upon the number of lights it has to supply. We should employ wires 1 in. diameter, and increase their number as the demand for electric lights increased. The iron pipes would be laid first and fitted with road boxes every fifty yards, and the leads drawn in afterwards as occasion requires.

QUESTIONS.	METROPOLITAN (BRUSH).	EDISON.	JABLOCHKOFF.	SWAN.	FERRANTI, THOMPSON, AND INCE.	"PILSEN"-JOEL.	SIEMENS BROTHERS AND Co.
16. Does your system include the use of accumulators, if so, of what kind and where are they to be fixed?	Our system includes the use of accumulators of the usual kind, although we are not dependent upon them. They would be fixed in each house having the light, or at convenient intervals in or along the lines joining the lamps, or with the generators. Details not yet decided.	We do not recognise the use of accumulators as econonomical or necessary in the Edison system of distribution.	No accumulators necessary.	We propose to use accumulators as soon as they are fairly in the market. We consider they will be a most useful adjunct, but should be unable to tender for them in our present scheme.	No. We consider accumulators unnecessary for a compact district like Chelsea.	It is advisable in many instances to use accumulators.	It might be advisable to use accumulators, which could either be fixed in the houses or at the stations, or in both.
17. How is uniformity and steadiness of light maintained?	The uniformity and steadiness of the Brush Arc Light is maintained by the excellence of the regulator and the homogeneity of the carbons. Those of the incandescent light by the supply of current being uniformly delivered through the lamps. The use of secondary batteries renders the result doubly sure.	The nature of the Edison system is such that absolute steadiness and uniformity in the lighting is secured.	A good *steady-going* engine, *perfect* conductors, and *pure carbons*, are a safe guarantee to a perfect light.	By dividing our plant into several sets of generating machinery, each consisting of one steam-engine and several dynamo machines, each set being further controlled by an electric governor, which varies with the speed of the engines according to the electromotive force of the mains.	By driving large dynamo from large engine at a uniform speed. Our present lights so run keep perfectly steady.	By providing adequate power and accumulators, if possible, but *more especially* in having a form of lamp the working of which is *automatic*.	Uniformity and steadiness of light would be attained by employing efficient governors with the steam-engines, and by the use of accumulators.
18. What provisions have you for keeping the lights going in case of a breakdown in the machinery?	Duplicate machinery and accumulators.	By the immediate switching in of a spare dynamo. Thus with a central station having, say, *six* large dynamos, only *five* would be employed at once. The breakdown of one of these would produce (owing to the regulating arrangements) no discernable variation of the light, and the time required to put spare machine in action would not exceed one minute.	Duplicate engines and dynamos.	The full number of sets will normally be worked at from $\frac{1}{4}$ to $\frac{3}{4}$ of their maximum out-turn of current, so that if by accident any one or even two sets should be disabled, the engines of the other sets would only have to increase their speed and maintain the normal electromotive force, and supply all current in the mains. This arrangement of several sets of machinery all run into one main, also insures great uniformity and regularity in the supply of the current.	A spare engine and dynamo would be quite sufficient, as the machine is so simple and durable that there is little or no chance of failure or accident.	Accumulators will do this.	The accumulators would guard against a breakdown, and if they are not employed, spare machines would be kept in readiness to supply the place of broken down ones; or the electrical machines might be driven usually at a slow speed, so that if one of their number broke down, the remainder could be driven faster, and so keep up the supply.
19. How do you provide for the public safety, and against danger to property?	By the most perfect insulation or safety junctions, and every other available protection.	By a system of safety plugs throughout every part of the installation. Only in the Edison system is this carried out in a complete and efficient manner.	Proper insulation and ordinary precaution in workmanship.	Our electromotive force is so low that there would be no danger to life or even the least personal inconvenience to persons touching the wires. Regarding danger from fire from improperly arranged conductors, we propose to submit all our work to the inspection of the officials of the Fire Insurance Companies. With ordinary precautions we are convinced that danger from this source is far less than from any other method of lighting.	By perfect insulation and good workmanship, and this could be done under supervision of your own inspector.	By doing the work carefully, intelligently, and in a manner to meet the conditions of the case.	The leads being underground would be inaccessible, and the electromotive force being kept low, no danger could result even if anybody came in contact with the leads. We should also observe the rules drawn up by the Council of the Society of Telegraph Engineers with regard to fire risks from electric lighting, a copy of which we enclose.

We have only referred to a few of the leading questions, but we must confess with Mr. Stayton that a careful perusal of the tabulated statement reveals a somewhat curious diversity of opinion as to the manner in which the work should be done, and the result of the inquiries is undoubtedly disappointing, as many of the answers are very indefinite or incomplete.

Summed up the case stands thus: only three companies would contract to light any portion of Chelsea, the Brush, Jablochkoff, and Ferranti, Thompson, and Ince; but the companies were not prepared to give terms, excepting the Jablochkoff, which would undertake the work conditionally for 1½d. per lamp per hour. It appears from this that the Jablochkoff Electric Light Company is the only one at present prepared to do any work on an extensive scale, or with any definite knowledge of the extent of its resources. This, perhaps, is nothing to be surprised at, for the Jablochkoff system has been in operation longer than any other in England, and although worked in a quiet sort of way, there is no doubt but that the representatives of this system have amassed a considerable amount of experience, which now stands them in good stead. We have every reason to believe that this company will eventually take a leading position amongst electric lighting companies—a position which should never have been, for the time being, lost. *Apropos* of this we refer our readers to the article on the Dandeu-Chertemps machine, containing a report by Mr. Robert Sabine. Returning to the original subject of our remarks, we find that Mr. Stayton comes to the following conclusions:—

1. That at present it is not desirable for the vestry to apply for a licence or provisional order.

2. That it is not desirable to consent to any application for a licence until the draft shall have been submitted to, and has received the approval of, the vestry.

3. That the solicitors be instructed to watch the progress of the applications for provisional orders, and to take all necessary steps to oppose the same until satisfactory conditions are obtained.

4. That it is desirable to support the application of any company who may appear most likely to carry out the undertaking in a satisfactory manner, and who will agree to such of the suggested conditions as the Board of Trade may approve; and that the Electric Lighting Committee and the surveyor be empowered to enter into the necessary negotiations for effecting that object.

The report as a whole is one of the most comprehensive and complete which we have had the pleasure of perusing, and it demonstrates how valuable must be the advice of a competent engineer in assisting a local authority in arriving at a definite decision. That the Chelsea Surveyor is really a supporter of the electric light may be inferred from his remark that "although gas has done good service in the past, and will no doubt be continued both as an illuminant and heating power, yet its manufacture and consumption create many evils. There can therefore be but little doubt that so soon as greater economy in the production of electricity can be satisfactorily proved, it will gradually supersede gas for lighting purposes to a considerable extent."

THE ROYAL SOCIETY.

(*Continued from page* 447.)

The subject of Technical Education has continued to be prominently under the notice of the country during the past year. The appointment of a Royal Commission on Technical Instruction, to which I have previously referred, has done much towards awakening the interest of manufacturers, and exciting curiosity in regard to the efforts that are being made abroad to improve the education of artisans. The Commissioners issued in March last their first Report, which dealt exclusively with primary education and apprenticeship schools. The Commissioners expressed an opinion adverse to the establishment of apprenticeship schools in this country; and in this view they are supported by nearly all our large manufacturers, and by the action of the City and Guilds of London Institute for the Advancement of Technical Education. At the request of the Executive Committee, I myself gave evidence before the Commission, explaining generally the objects of the City Guilds and Institute, and describing the progress already made towards their attainment. As a member of the Executive Committee of this Institute, I have watched its progress with interest, and have observed with satisfaction that its scheme of Technical Instruction is being gradually matured. The general Examinations in Technology undertaken by this Institute, were held in May last at 147 centres in 37 subjects. Of the 1,972 candidates who presented themselves for examination, 235 passed in Honours, and 987 in the Ordinary Grade. In 1881, 895 candidates passed, showing an increase of 307. The examinations were held this year for the first time under the revised regulations, which appear to have worked very satisfactorily. Two points deserve notice with respect to these examinations. In the first place, the Institute experiences very great difficulty in obtaining properly qualified teachers. The applicants are either practical men working in the factory, or at their trade with no scientific knowledge whatever, or men possessing a very elementary science knowledge, and little or no practical acquaintance with the details of the industry, the technology of which they profess to understand. In order to indicate the kind of qualifications required in an ordinary technical teacher, the Institute has inserted in its programme a paragraph to the effect that persons who are engaged in teaching science under the Science and Art Department, and who at the same time have acquired a practical knowledge of their subject in the factory or workshop, may be registered as teachers of the Institute. The second point calling for consideration is the fact referred to in the Report of the directors: that of the 1,222 candidates who, this year, passed the examinations, most of whom are workmen or foremen in various branches of industry, not more than 450 are qualified to receive the full technological certificate, by having previously passed the examinations of the Science and Art Department in certain science subjects. This fact clearly indicates that widely beneficial as has been the action of this department of State, there is still a large field for its influence among the population who are engaged in manufacturing processes and desire to receive technical instruction.

One of the most satisfactory results of the examinations of the City and Guilds of London Institute is the impulse they have given to the establishment, in different parts of the country, of properly equipped technical schools. At Manchester, Preston, Dewsbury, Hawick, Sheffield, Leicester, and other places, efforts have been made during this year towards organising schools for the technical instruction of artisans and others in the application of science and art to specific industries. At Nottingham, a grant of £500 has been made by the Institute, to be followed by an annual contribution for a limited period of £300, towards the establishment of technical classes in connection with the University College; and at Manchester a subscription of £200 a year has been promised to assist the funds now being raised for the conversion of the Mechanics' Institution into a Technical School. The attention of the Council has been greatly occupied of late with the arrangements for the opening of the Finsbury College. Classes in electrical engineering and in technical chemistry have been carried on for nearly three years in temporary rooms belonging to the Cowper Street Schools. The attendance at these classes has been eminently satisfactory, much more so than could have been anticipated. During the past session 960 class tickets were sold at fees varying from 5s. to 12s. The staff of the College has recently been doubled by the appointment of a professor of mechanical engineering and a head master to the new department of applied art, the establishment of which, as I stated last year, was then under the consideration of the Committee. In January next, it is anticipated that the new building in Tabernacle Row, which is already nearly completed, will be opened for the reception of students. The programme of instruction, prepared by the director and the professors of the College, has been for some time under the consideration of the Committee, and it is hoped that in the instruction given in this College will be found the realisation of a very important part of the Institute's scheme of technical education.

Grants to the technical science classes at University College and King's College, London, to the Horological Institute, to the School of Art Wood Carving, and other institutions, have been continued during the past year.

The Technical Art School in Kennington Park Road, established and maintained by the Institute, has been satisfactorily attended; and a proposition is to be brought before the Committee for supplementing the teaching of this school by technical science classes, with the view of establishing in the south of London a technical college for artisans, similar to the one about to be opened in Finsbury.

The building of the Central Institution or Technical High School in Exhibition Road, the foundation-stone of which was laid by H.R.H. the Prince of Wales, President of the Institute, in July, 1882, is rapidly advancing, and promises to be completed within a year. It is not expected, however, that this school will be ready for the reception of the students before the commencement of the session 1884-5. Meanwhile, the Council and Committee are fully occupied with the development of other parts of their scheme. . . . . .

This is, perhaps, the proper place to make mention of some results having an important bearing on meteorology, obtained by Prof. Tyndall in the course of a larger research on the action of radiant heat on gases.

By methods which he has applied to gases and vapours generally, Tyndall has established anew the action of aqueous vapour upon radiant heat, and the sensibly perfect diathermancy of dry atmospheric air. The phenomena of solar and terrestrial radiation are profoundly modified by the presence of aqueous vapour in the earth's atmosphere, the temperature of our planet being thereby rendered very different from what it would otherwise be.

The celebrated experiments of Patrick Wilson, wherein were observed a rapidity of radiation and a refrigeration of the earth's surface previously unknown, are explained by the fact that when they were made the amount of aqueous vapour in the air was infinitesimal, the unhindered outflow of heat towards space being correspondingly great. The sagacious observation of Six and Wells, that the difference between the surface temperature and that of the air a few feet above the surface, on equally serene nights, is greatest in cold weather, is explained by the fact that when the temperature is low, the agent which arrests the surface radiation is diminished in quantity. Wells, moreover, found that the heaviest dews were deposited on nights when the difference between air temperature and surface temperature was small; while the greatest difference between the two temperatures was observed on nights when the deposition of dew was scanty. The explanation offered by Tyndall is this:—copious dew indicates abundant vapour; and abundant vapour, by arresting the terrestrial rays, prevents the refrigeration observed in drier air. Strachey's able discussion of observations made at Madras, points distinctly to the action of aqueous vapour on the radiation both of the sun and of the earth; while the experiments of Leslie, Hennessey, Hill, and other distinguished men, which were long considered enigmatical, are readily explained by a reference to the varying quantities of vapour with which the atmosphere is charged, on days of equal optical transparency. The interesting observations of Desains and Branley, made simultaneously on the Rigi and at Lucerne, are well worthy of mention here. The difference of level between the two stations is 4,756 feet, and within this stratum 17·1 per cent. of the solar heat was proved to be absorbed. This absorption being due to aqueous vapour, is tantamount to the tranmission of the sun's rays through a layer of water of a definite thickness. A sifting of the rays would be the consequence, and on *à priori* grounds we should infer that the percentage transmission through water at Lucerne must be greater than on the summit of the Rigi. This was the exact result established experimentally by Desains and Branley. H. Wild, the distinguished Imperial Astronomer of St. Petersburg, basing his statement on experiments made by himself according to Tyndall's method, has expressed the opinion "that meteorologists may, without hesitation, accept this new fact in their endeavours to explain pheno-

mena which hitherto have remained more or less enigmatical." The correctness of this statement is illustrated by the foregoing examples, to which, if necessary, many more might be added. . . . . .

The scientific year now concluded has not been so fertile as its predecessor in the initiation of great national and international undertakings, neither have any of those larger enterprises which I took occasion to mention last year, such as the circumpolar observations, or the Transit of Venus Expeditions, as yet been brought to their final issue. Nevertheless, in some of them we have evidence that good work is already being done, and in the others, of which we have as yet no information, there is no reason to doubt that the same is the case. Nor again, in the border-land between science proper and its applications, have I to record anything so important as the Paris Electrical Exhibition. That Exhibition, however, bore legitimate fruit in the Electric Lighting Exhibition at the Crystal Palace, and in the technical experiments lately carried out on a large scale at Munich. Perhaps the most prominent feature of the Crystal Palace Show was the incandescent light. At Paris that mode of illumination appeared to be little more than a possibility, in London it had become an accomplished fact. The importance attaching to this advance in electric lighting may be measured both by the rapid extension of its use, and also by the fact that not a few of our leading minds consider that the incandescent lamp is the lamp of the future, not merely for domestic, but even for many other public purposes.

But in another way the present year has witnessed the most important step which could have been taken for the promotion of electric lighting in this country. The Legislature has passed the Electric Lighting Bill, and, so far as legislation can effect the object, it has brought electricity to our doors. Up to this time installations of greater or less magnitude had sprung up sporadically in many parts of the country, in railway stations, manufacturing works, and occasionally in private houses. But, compared with the lighting of a whole town, or even of separate districts of a large city, even the most important of these must be confessed still to partake of the nature of experiments; experiments, it is true, on a large scale, and, as I believe, conclusive as to the ultimate issue. Indeed, by multiplication of machines it is certainly, even now, possible to increase the lighting power to any required extent; but this can hardly be regarded as the final form of solution of the problem, inasmuch as such a method would be as uneconomical as it would be to use a number of small steam-engines instead of a large one. And when we consider that at the time of the passing of the Act in question, there was but one machine actually constructed which was capable of illuminating even one thousand incandescent lamps (I mean that of Edison), we cannot but feel that much remained to be done before the requirements of the public could be fully met. I do not mean thereby to imply that the Act was passed at all too soon; on the contrary, it has already given just that impetus which was necessary for producing installations on a larger scale. In illustration of this, I cannot help mentioning, as the first fruit of the impetus, a remarkable machine, by our countryman Mr. J. E. H. Gordon, which appears capable of feeding from five to six thousand lamps.

But beside the impulse above described, the Bill will have a scientific influence perhaps not contemplated by its original promoters. Under this Act, for the first time in the history of the world, energy will come under the grasp of the law, will become the subject of commercial contracts, and be bought and sold as a commodity of everyday use. It is, in fact, far from improbable that the public supply of electricity will be reckoned and charged for in terms of energy itself. But whether this be literally the case or not, a measurement of energy must lie at the root of every scale of charge.

And, further, since the Act allows no restriction to be placed upon the use of the electricity so supplied, it follows that it may be used, and undoubtedly will be used, at the pleasure and convenience of the customer, either for lighting, or for heating, or for mechanical, or for chemical purposes. This being so, it is clear that the public must by this process become, practically at least, familiar with the various modes of the transformation of force; and the Act in question might, from this point of view, have been entitled An Act for the better Appreciation of the Transformation of Force.

While offering to the public this new commodity, electricians may, in one respect, especially congratulate themselves, namely, that their article is incapable of adulteration. An electric current of a given strength and given electromotive force is perfectly defined, and is identically the same, whether it comes from a Siemens or a Gramme, from a magneto or from a dynamo machine, or as suggested by an eminent counsel before the Select Committee of the House of Commons, from one machine painted red or from another painted blue.

It has been said, and perhaps with truth, that the electric light will be the light of the rich rather than that of the poor. But in more ways than one electricity may now become the poor man's friend. The advantages in avoidance of heat and of vitiated atmosphere in workshops and factories have often been pointed out, and may ultimately become an important factor in the physical growth and prosperity of our population. But besides this, when electricity is literally brought to our doors, it will become possible, by converting it into motive-power of limited extent, to revive some of the small industries which, during the last half century, have been crushed by the great manufacturing establishments of the country. There are operations which are capable of being carried out by the wives and families of workmen; there are works of small extent which can be performed more advantageously in a small establishment than in a large one, and it can hardly fail to be a gain to the community if this new departure should give fresh opportunities for the development of our industry in these directions. . . . . .

A Royal Medal has been awarded to Lord Rayleigh, M.A., F.R.S.

The researches of Lord Rayleigh have been numerous and extend over many different subjects; and they are all characterised by a rare combination of experimental skill with mathematical attainments of the highest order.

One class of investigations to which Lord Rayleigh has paid much attention is that of vibrations, both of gases and of elastic solids. The results of most of these researches are now embodied in Lord Rayleigh's important work on the "Theory of Sound"—a work which not only presents the labours of others up to the time of writing in a digested and accessible form, but is full of original matter.

The subject of vibrations naturally leads on to a mention of other hydro-dynamical researches. Lord Rayleigh has investigated the motion of waves of finite height, and in particular has shown that the "great solitary wave" of our late Fellow, Mr. Scott Russell, has a determinate character; and he has investigated the circumstances of its motion to an order of approximation sufficient to apply to waves of considerable height.

Lord Rayleigh has examined more fully than had previously been done the theory of diffraction gratings, and the effects of irregularities; and also investigated the defining power of optical combinations, and its limitation by diffraction and spherical aberration.

He has lately been engaged in the elaborate re-determination of the B.A. unit of electrical resistance. . . . . .

The attention of chemists had for many years past been directed to the relations between the atomic weights of the elements and their respective physical and chemical properties; and a considerable number of remarkable facts had been established by previous workers in this field of inquiry.

The labours of Mendeleeff and Lothar Meyer have generalised and extended our knowledge of those relations, and have laid the foundation of a general system of classification of the elements. They arrange the elements in the empirical order of their atomic weights, beginning with the lightest and proceeding step by step to the heaviest known elementary atom. After hydrogen the first fifteen terms of this series are the following, viz:—

Lithium	7	Sodium	23
Beryllium	9·4	Magnesium	24
Boron	11	Aluminium	27·4
Carbon	12	Silicon...	28
Nitrogen	14	Phosphorus	31
Oxygen	16	Sulphur	32
Fluorine	19	Chlorine	35
		Potassium	32

No one who is acquainted with the most fundamental properties of these elements can fail to recognise the marvellous regularity with which the differences of property, distinguishing each of the first seven terms of this series from the next term, are reproduced in the next seven terms.

Such periodic reappearance of analogous properties in the series of elements has been graphically illustrated in a very striking manner with respect to their physical properties, such as melting-points and atomic volumes. In the curve which represents the relations of atomic volumes and atomic weights analogous elements occupy very similar positions, and the same thing holds good in a striking manner with respect to the curve representing the relations of melting-points and atomic weights.

Like every great step in our knowledge of the order of nature, this periodic series not only enables us to see clearly much that we could not see before; it also raises new difficulties, and points to many problems which need investigation. It is certainly a most important extension of the science of chemistry.

REVISED EDITION OF PATENT RULES.

(*Continued from page* 451.)

DIRECTIONS AS TO *Sizes and Methods of Preparing* PETITIONS, DECLARATIONS, COMPLETE SPECIFICATIONS, DRAWINGS to accompany the same, and COPIES thereof.

XXIX. All petitions for the grant of letters patent, and all declarations, shall be respectively written or printed upon sheets of paper of twelve inches in length, by eight inches and a half in breadth (but on one side only), leaving a margin of one inch and a half on every side of each page.

XXX. All complete specifications accompanying petitions for the grant of letters patent shall be respectively written or printed bookwise upon a sheet or sheets of parchment, each of the size of twenty-one inches and a half in length by fourteen inches and three-fourths in breadth; the same may be written or printed upon both sides of the sheet, but a margin must be left of one inch and a half on every side of each page.

XXXI. The drawings accompanying such complete specifications shall be made upon a sheet or sheets of parchment, each of the size of twenty-one inches and a half in length by fourteen inches and three-fourths in breadth, or twenty-one inches and a half in breadth by twenty-nine inches and a half in length, leaving a margin of one inch and a half on every side of each sheet.

XXXII. The copy of the complete specification to be left at the office of the commissioners on filing the complete specification, shall be written or printed upon sheets of brief or foolscap paper, brief-wise, and upon one side only of each sheet.

XXXIII. The copy of the drawing, or drawings, to be left with the copy of the complete specification, must be made upon good white smooth-surfaced drawing paper of the same dimensions as the parchment drawing. All the lines must be absolutely black, Indian ink of the best quality to be used, and the same strength or colour of the ink maintained throughout the drawing. Any shading must be in lines, clearly and distinctly drawn, and as open as is consistent with the required effect. Section lines should not be too closely

drawn. No colour must be used for any purpose upon this drawing. All letters and figures of reference must be bold and distinct. The border line should be one fine line only. The drawing must not be folded, but must be delivered at the office of the commissioners either in a perfectly flat state, or rolled upon a roller, so as to be free from creases or breaks.

XXXIV. In all cases where the original drawing on parchment is coloured, there must be left, in addition to the above copy, another copy coloured.

TRANSMISSION OF COPIES, TRANSCRIPTS, &c., TO EDINBURGH AND DUBLIN.

XXXV. The office of the director of chancery in Scotland, being the office appointed by the Act for the recording of transcripts of letters patent, shall be the office of the commissioners in Edinburgh for the filing of copies of specifications, disclaimers, memoranda of alterations, provisional specifications, and certified duplicates of the register of proprietors.

XXXVI. All such transcripts, copies, and certified duplicates shall be bound in books, and properly indexed, and shall be open to the inspection of the public at the said office, during office hours, every week-day, except 1st January, 10th February, Good Friday, Queen's Birthday, 20th June, 28th June, 9th November, and 25th December.

XXXVII. The charge for office copies of such transcripts, copies, and certified duplicates, recorded and filed in the said office, shall be at the rate of twopence for every ninety words.

XXXVIII. The Enrolment Office of the Court of Chancery in Dublin (late Rolls Office, now Record and Writ Office) being the office appointed by the Act for the enrolment of transcripts of letters patent, shall be the office of the commissioners in Dublin for the filing of copies of specifications, disclaimers, memoranda of alterations, provisional specifications, and certified duplicates of the register of proprietors.

XXXIX. All such transcripts, copies, and certified duplicates shall be bound in books and properly indexed, and shall be open to the inspection of the public at the Public Record Office of Ireland during office hours on every working-day.

XL. The charge for office copies of such transcripts, copies, and certified duplicates, enrolled and filed as aforesaid, shall be at the rate of twopence for every ninety words.

(Signed) SELBORNE, C.
G. JESSEL, M.R.
HENRY JAMES, A.G.
FARRER HERSCHELL, S.G.

Dated the 8th day of November, 1882.

APPLICATIONS TO THE LORD CHANCELLOR.

Ordered by the Right Honourable Roundell Baron Selborne, Lord High Chancellor of Great Britain:

I. Every application to the Lord Chancellor against or in relation to the sealing of letters patent shall be by notice, and such notice shall be left at the office of the commissioners, and shall contain particulars in writing of the objections to the sealing of such letters patent.

II. Whereas by the Act 16 & 17 Vict. c. 115, the Lord Chancellor is empowered to extend the time for the sealing of letters patent for an invention, and for the filing of the specification thereon, limited to the period of one month after the expiration of the six months of provisional protection of such invention, provided the delay in sealing such letters patent and in filing such specification has arisen from accident, and not from the neglect or wilful default of the applicant.

It is ordered as follows:—

Every petition addressed to the Lord Chancellor, praying for the extension of time for the sealing of letters patent, and for the filing of the specification thereon under the provisions of the Act of the 16 & 17 Vict. c. 115., and the affidavit accompanying the same shall be left at the office of the Commissioners of Patents. And in every case where the delay in sealing such letters patent and in filing such specification is alleged to have been caused by adjourned hearings of objections to the grant of such letters patent before the law officer to whom such objections may have been referred, the petitioner, before leaving his petition as aforesaid, shall obtain the certificate of such law officer to the effect that the allegations in respect of such adjourned hearings and causes of delay are, in the opinion of such law officer, correct, and that the delay arising from such adjourned hearings has not been occasioned by the neglect or default of the petitioner; and such certificate shall be written at the foot of or shall be annexed to such petition.

(Signed) SELBORNE, C.

Dated the 8th day of November, 1882.

LAW OFFICERS' ORDERS.

Ordered by Sir Henry James, Her Majesty's Attorney-General, and Sir Farrer Herschell, Her Majesty's Solicitor-General:

I. In every application for letters patent, the applicant must insert in the petition and in the declaration his full name and his address or his principal address, if he have more than one residence or place of business; but only one address must be given.

II. In every application for letters patent for an invention which is not the discovery of the applicant, the petition and the declaration must state the source of the invention in the following form, or to the following effect:—

(*a.*) That it is a communication from [*A.B.*], a person resident at [*here state address*].

(*b.*) That it is the result partly of a communication made to me by [*A.B.*], a person resident at [*here state address*] and partly of invention and discovery made by me.

(Signed) HENRY JAMES, A.G.
FARRER HERSCHELL, S.G.

Dated the 8th day of November, 1882.

LIST OF STAMP DUTIES AND FEES PAYABLE ON AND IN CONNECTION WITH LETTERS PATENT.

ON APPLICATION WITH PROVISIONAL SPECIFICATION.

	£	s.	d.
Stamp on petition for letters patent	5	0	0
To be paid on giving notice to proceed	5	0	0
To be paid on applying for warrant and patent ...	10	0	0
Stamp on final specification	5	0	0
Total cost of patent for three years	25	0	0

ON APPLICATION WITH COMPLETE SPECIFICATION.

Stamp on petition for letters patent	5	0	0
Stamp on complete specification	5	0	0
To be paid on giving notice to proceed	5	0	0
To be paid on applying for warrant and patent ...	10	0	0
Total cost of patent for three years	25	0	0

SUBSEQUENT PAYMENTS TO CONTINUE THE PATENT IN FORCE.

Stamp on patent before expiration of 3rd year	50	0	0
Ditto ditto 7th year	100	0	0
Total cost of patent for fourteen years	175	0	0

ON OPPOSITION TO GRANT OF LETTERS PATENT.

To be paid by person opposing grant, on giving notice of objection...	2	0	0
To be paid by petitioner, also by person opposing grant, on the hearing of the case of opposition, each ...	3	10	0

ON OPPOSITION TO THE SEALING OF LETTERS PATENT.

To be paid by person opposing the sealing, on giving notice of objection...	2	0	0

ON DISCLAIMERS, MEMORANDA OF ALTERATIONS, AND OPPOSITIONS THERETO.

Stamp on petition for leave to file a disclaimer or a memorandum of alteration	5	0	0
Stamp on caveat against a disclaimer or a memorandum of alteration	2	0	0
To be paid by petitioner for the hearing previous to the fiat of the law officer	3	5	0
To be paid by person opposing allowance, on the hearing of the case of opposition	3	5	0
To be paid by petitioner for fiat of law officer allowing a disclaimer or a memorandum of alteration	3	15	6

OTHER PAYMENTS.

On registering assignment, licence, &c.	0	5	0
For duplicate of letters patent	5	0	0
For every search and inspection	0	1	0
For office copies, every 90 words	0	0	2
For certifying every printed copy of a specification ...	0	1	0

(Signed) SELBORNE, C.
G. JESSEL, M.R.
HENRY JAMES, A.G.
FARRER HERSCHELL, S.G.

Dated the 8th day of November, 1882.

Office of the Commissioners of Patents,
25, Southampton Buildings, Chancery Lane, W.C.

ON THE APPLICATION OF ELECTRO-MOTIVE POWER TO MARITIME PURPOSES.

By A. RECKENZAUN, C.E.

THE honourable distinction of bringing the scheme of steam navigation to a successful issue is due to Fulton; he, we are told, had long been studying the steam-engine of his time, solely with a view to its employment in the propulsion of vessels. Learning that a steam-boat was being built in Scotland, as an experiment for Lord Dundas, he visited this country in the year 1802, and gained some useful information in the very diminutive engine-room of this model boat called the "Charlotte Dundas." From England Fulton went to France, in the hope of influencing the interest of Napoleon in his design, and to obtain that emperor's support in this his great project. Fulton returned to America, however, disappointed, for Buonaparte refused any assistance; so he then, nothing daunted, executed the drawing which he sent to Boulton & Watt for them to construct the machinery therefrom, since it was desirable this should be carried out in the best manner then known. In the year 1807 Fulton launched his first steam-vessel on the River Hudson, and which for a long time ran regularly between New York and Albany,

steaming at a speed of four miles an hour; subsequently increased to six miles per hour.

Fulton's success in America soon called the attention of the Scotch engineers to the marine engine, but it remained for another than Symington, the designer and constructor of the "Charlotte Dundas," to develop this grandest of all grand industries in Great Britain.

I have referred thus briefly to these well-known facts in the early history of the development of the marine-engine, and of those connected with it, because it is well at all times to bear in mind how ardently must those first pioneers have worked, how steadfastly they pursued their object in spite of so many and such enormous difficulties, disappointments, and opposition. They laboured under the disadvantages of an imperfect knowledge of physical science; they had no approved theories upon which to found their practice; no books to assist them in collecting, comparing, and arranging facts; no societies where they could discuss their views; nor did they possess the simplest instruments or even the tools needful to produce the desired results. Nevertheless they and their successors ultimately succeeded admirably, although we must admit that their representatives of to-day are neither idle nor oblivious to the fact that perfection has not yet been attained. Fuel is expensive and requires much room, which can ill be spared in these high-pressure days, amid the keen race between competition and demand; and acting upon the worthy precept to—

> . . . "Count nothing done
> While aught remains to do,"

Man, ever eager to press into his service all and everything around him, has been for years past striving to tame the very lightning, so to speak, and make it contribute to his thirst for gain. Thus of late what has been for years naught but the assumption of theorists, the dream of physicists and the firm conviction of perhaps one (Faraday) has at last assumed a practical shape. We have to-day within the ken of the "oldest inhabitant" the vast change from the rushlight and horn-lantern of his childhood to the brilliant, almost blinding illumination of the electric light; and from the postchaises and heavy-rolling rumbles, and the slow-paced canal-barge of his youth to the electric railway and, may I not add, the electric-launch of to-day.

This leads me to the subject with which we are more immediately concerned at present, viz., this storer and conveyer of motive-power and its general adaptability to various purposes connected with navigation.

To the designer and constructer of the first *successful* electric-boat comparatively small credit is due: he had at his disposal volumes of knowledge; theories, formulæ, calculations, facts worked out by his forerunners ready to his hand; the most perfect tools to work with; he could get his electric-motor ready made. His sole task was in the application and adaptation of known contrivances, and all that he required beyond this was a practically useful battery; this was furnished as quickly, as skilfully, and as complete as he could desire.

Upon the subject of the storage of electricity, Prof. Silvanus Thompson presented us a year ago with his advanced views; dwelling, with a charming command of language and knowledge, upon the great advances recently made in science and their ultimate importance to industry in general; and, whilst developing his subject from the general laws of voltaic electricity to their particular adaptations, he encouraged the world to further research with the promise of ultimately attaining still grander results. More recently this *savant* gave us, through the Press, a short account of the labours of Jacobi and Trouvé.

Jacobi, Professor Thompson tells us, constructed an electric-boat at St. Petersburg, in the year 1838, on which an electro-magnetic engine was worked by a Daniell's battery, composed of 320 couples of zinc and copper, each 36 square inches in area, but the speed attained was not more than $1\frac{1}{4}$ miles per hour. In the following year Jacobi made an improvement, however, by substituting 68 Grove cells—the area of the platinum plates being the same as that of his zincs in the Daniell battery. The boat was 28 feet long by $7\frac{1}{3}$ feet beam and less than 3 feet in depth; it held 14 persons and reached a speed of $2\frac{1}{4}$ English miles per hour on the river Neva.

The ELECTRICAL REVIEW, in an article on electrical navigation, records an attempt made upon the lake in the Bois de Boulogne in 1859 to navigate a boat by electricity, but it does not inform us of the name of its originator.

These attempts at utilising primary batteries for motive-power proved, *naturally*—as present experience has taught us — failures. Professor Carey Foster demonstrated the fallacy of consuming zinc instead of coals, six years ago, in a very interesting discourse at South Kensington. Professor Foster said that there seemed to be no reason to believe that electricity could ever be economically used as a motive-power; the cost of fuel for smelting an amount of zinc sufficient to do a certain amount of work would be much more profitably spent in doing work *directly* in a steam-engine. This is quite true so far; but we must wonder why this learned man, who, perhaps better than any others, must have known of the existence of the Planté secondary battery, did not in any way refer to its usefulness. The Planté cell has been known for many years, but comparatively little importance has been assigned to this grand discovery; indeed, we began but very recently to realise that it must be counted as one of the grandest, one of the most useful of this century.

M. Trouvé, of Paris, was one of the first to utilise the Planté accumulator for motive-power purposes, and he was the first who propelled a boat by means of these cells and an electro-motor of his own construction. This experiment he successfully carried out on the River Seine.

The Faure battery is a modification of the Planté, and so are a large number of others (including the Sellon-Volckmar accumulator) which have been brought into the world—at any rate as far as the Patent Office—during the past twelve months.

The original Faure accumulator differs very little in appearance from the Planté, but gives slightly different results under certain circumstances. The Sellon-Volckmar accumulator, although composed of the same materials, seems to be superior to its forerunners, both in mechanical effect and durability: it is *absolutely certain* in its action, is compact, simple, and produces a maximum efficiency as regards weight and power.

Faure places the oxide of lead upon the surface of the lead-plates; the red lead is applied in the form of paint, and this paint is kept upon the plates partly by its natural adhesion and partly by the mechanical pressure exerted by the substance dividing the plates. The uncertainty of action with many of these accumulators is caused principally by the separation of the lead from its oxide; thus the superior mechanical construction of the Volckmar lead-plates is a decided advance in the right direction.

Mr. Volckmar perforates his lead-plates and fills the perforations with the oxide, and in such a manner that it is entirely prevented from falling out or separating; in fact we can bend these plates considerably without destroying their efficiency. This is not only a good quality, it is *absolutely essential* to purposes of conveyance from place to place under the influence of vibration, such as exists on railways, tramcars, and boats.

However, I propose to confine myself to the application of electric energy to purposes directly connected with the navigation of the sea and rivers.

In order to render this motive-power of use on board a ship it must show superior qualities; electrical power, to be useful, must be as convenient and as cheap as steam-power; it must be certain in action at all times and under all circumstances; the appliance for conveying electric energy must be compact, light, easily managed and manipulated by a man of ordinary intelligence, free from danger, and always under command.

Space and weight are probably of first importance in this connection; next, however, comes the cost—prime cost, maintenance, the consumption of material, waste, and wear and tear. Keeping within the bounds of experience, I can show that, for small vessels, such as launches, torpedo-boats, &c., electrical machinery has a decided advantage, space for space, over that required for steam-power; hence in this description of craft it will doubtless become a successful rival. A steam boiler is always a bulky object when compared with the size of a boat; the steam-engine, although comparatively small, is still not so convenient in shape as a dynamo machine or electro-motor. The accumulators, though heavier, can be as easily stowed away as coals and possess this additional advantage over coal that their weight does not diminish;

thus they are greatly superior as ballast, and maintain a constant and invariable draught of water for the propeller to work upon. An electro-motor giving out, say, 10 horse-power will not weigh more than 10 cwt. and, when fixed to the floor horizontally, need not stand higher than 15 inches; therefore, if we work the screw-propeller direct from the motor, the space occupied by the whole machinery is very inconsiderable. The weight of a 10 horse-power electro-motor, as I have said, need not exceed 10 cwt., whereas that of a 10 horse-power marine-engine with all its accessories, but *without* the boiler, amounts to at least 15 *cwt.*—machine for machine; thus we have a great gain in favour of the motor. Horse-power taken by the dynamometer on the screw shaft and *not* the indicated horse-power.

In a steamboat we have further to consider the weight of the steam-producer—the boiler—and that of the fuel; on the other hand for our electric-boat we must calculate that of our current-producer—the battery. We naturally assume a definite number of hours during which our supply of fuel or *force* may be required to last. Now, on a steam-boat, in order that it may run, say, 10 hours, with a 10 horse-power engine, we must carry about 10 cwt. of coals and a boiler which, when filled, weighs at least 30 cwt.—or together, without the engine itself, about two tons; adding to this the engine, we find we have no less a load to carry than some 55 cwt. On the other hand, on an electric-boat the batteries in order to be durable will weigh 50 cwt., which makes with the motor, say, 60 cwt. in all; but if we have thus nothing to balance in favour of electric-power, yet steam-launches seldom run continuously for any considerable time without stoppages for different purposes, and it is on these stoppages that we gain very materially, for, to maintain the steam in constant readiness to start, we must keep up a steady fire, and this means continuous consumption of fuel with no corresponding work done; our accumulators, on the other hand, consume practically nothing of our electric-force while at rest and, what is of greater moment still, no one has to stand by to attend to them during that time; they are perfectly safe and even improve by a little rest. They have what Professor Ayrton calls a resuscitating power; they regain strength and are thereby so much the better prepared for a start when the time comes. Since steam-boilers are dangerous they require the constant attendance of an engineer; since fires burn down they as surely demand the constant presence of a stoker.

A dynamo machine is composed of a very few pieces as compared with other engines, the fewer the details of a machine so much the less in proportion is the risk of a breakdown. In the case of a good dynamo there appears to be nothing of importance to get out of order. The commutator with its brushes seems really the only working part which wears or can give occasional trouble, and that but seldom, and only to a careless attendant. Fortunately we can easily carry a spare armature and plenty of spare brushes without the slightest inconvenience; moreover, all such vital parts of an electric engine can be always at hand, and be replaced at any moment with hardly any loss of time. If the wires are well protected the field-magnets cannot possibly get out of order; the armature, when securely wound, need never require attention. The only parts, then, are the bearings, the commutator, and the collecting-brushes, neither of which weighs more than a few pounds and can be replaced with ease, and as these working parts become improved, as we gain more experience still in this new branch of science, we may well look forward to obtaining in process of time an almost perfect motive-power.

The continents of America and Asia possess, in their rivers and canals, an immense natural system of internal communication; in fact, their waterways are as important as our railways; and it will, I doubt not, be in those countries that electric power will play a prominent part in inland communication. Those quarters of the globe are, by the same means, provided with an immense amount of water-power applicable to their needs. It would appear that a kindly providence has thereby supplied other means and natural forces where coal-fields are rare or absent; it only remains for man, therefore, to utilise them, transmit them to the most convenient centres of commerce and habitation, thus conferring incalculable advantages upon them. What does it matter if we have to transmit the water-power some 50 or 100 miles if we have the means of doing it at a profit? Is it not better to utilise 40 out of every 100 horse-power of energy contained in a waterfall, though it may be at a great distance from the place of its application, than to convey coals several thousands or even but hundreds of miles to the steam-engine? Having, then, these grand forces of nature at our disposal, and having discovered the means of turning them to good account, it is matter for surprise that more determined movement has not hitherto been made in this direction.

I do not know the limit of what might be done with electromotive power on inland waters or on the seaboard; but we have abundant evidence that it is very easy to run a distance of from 50 to 100 miles at a very considerable speed, sufficient for all practical purposes; but even if we were confined to very moderate distances there seems no reason why we should not erect stations for storage batteries at the necessary intervals whatever they may be.

With proper arrangements the whole set of cells can be taken out and replaced in an insignificantly short space of time, and the vessel can proceed at once, thus avoiding the delay occasioned by the necessity of recharging her own accumulators. But in many cases these generators could be established at those places where the vessels are compelled in any event to stop to load and unload their freight or debark their passengers; and while this is proceeding the cells may be charged through cables from the shore.

Proprietors of launches do not care themselves to undertake the necessary duties of watching the gauge-glasses and similar appendages to steam machinery; again—more unpleasant still to the delicate hands and mind of a yachtsman—there are the shovel, the dirty coals, the smoke, the heat, the smell of oil, matters quite inseparable from any steam-boat, even if the company of the dusty stoker be disregarded. Then the wages of these necessary helpers amount in the aggregate to more than the cost of the fuel; they must be there whether the passengers are on board or not; we may, therefore, well regard an electric-launch as a great boon, since it does not require any special skill in the management of its machinery, is free from heat and smell, from dirt and the need of constant attention, or the fear of explosion. I think it would add greatly to the pleasure of an excursion party if the course and the speed of their craft could be controlled quite independently of, not only wind and tide, but also of the company of an attendant. These advantages would, I am inclined to think, far outweigh every other consideration, even if the electric were as dear or dearer than steam-power.

Thus far I have simply dealt with pleasure-boats, of which there are thousands on the rivers, lakes, and bays of this and other countries; but the commercial world will demand further investigation: the man of business, the naval authorities, will require a more exact estimate of cost and maintenance, and not alone the proof of utility and greater convenience, ere they pronounce in favour of any novel contrivance, however excellent; and it is for this reason, and to meet this wider and more important demand, that I now propose to enter upon a more minute examination, and to put forward a few calculations respecting the power and cost of electricity, as here applied, and its adaptability to the purposes before us.

I take a lead plate $7\frac{1}{3}$ inches long, $5\frac{1}{4}$ inches broad, and less than $\frac{1}{8}$ inch in thickness; there are 560 square holes in this plate, and when these are filled with minium (lead oxide) it weighs less than *one pound!* A number of such plates are placed in a box, separated from each other by strips of wood, felt, or the like, and arranged so that every alternate plate is connected outside the box. We thus obtain two sets of connections, one of which will form the *positive*, the other the *negative* pole of the battery when charged; 40 of these plates with the separating material, acid, and box together need not weigh more than 50 lbs. They will, when charged, combine to produce a current of 50 ampères during a space of seven hours—or, in other words, 350 ampère hours. If discharged with a lower current, say, of 25 ampères they will last for at least fourteen hours—since the efficiency of any secondary battery depends upon the current and the time. All good secondary batteries, formed of lead with lead oxides in diluted sulphuric acid, give an electromotive force of 2·2 volts, thus we can accurately calculate the mechanical effect to be obtained from such an accumulator. Current × e.m.f.

× 44·25, will give us the number of foot-pounds; and this divided by 33,000 the actual horse-power. Therefore we get from the cell under consideration, with 40 plates, a force of ·134 horse-power per minute, or a total of about 56 horse-power in the seven hours—equal to a mechanical effect of 1,848,000 foot-pounds. Each plate—or nearly each pound of lead—would thus yield a power of $\frac{1,848,000}{40} = 46,800$ foot-pounds—an effect which has, probably, never been attained by any other accumulator (outside the laboratory).

Reducing our comparative figures with reference to the surfaces, we find that the two acting surfaces measure about 78 square inches in each plate, and the surfaces of the 40 plates combined give a total of, say, 3,120 square inches; thus we arrive at the conclusion that each square inch gives an energy of about 592 foot-pounds for seven hours and we have a current of one ampère for every 62·4 square inches. Every well-constructed accumulator gives, as I said, an e.m.f. of a little over two volts, and as this is a fixed quantity, whatever the surfaces or the number of plates, we can with ease arrange our calculations for any requirements and easily determine the number and size of our cells so soon as we know the required force. If, for example, we had to construct an electric-launch requiring an actual force of four horse-power for its propulsion, we should proceed first to determine the electrical energy necessary to run our motors; we know that a good dynamo-machine will yield an efficiency of 75 per cent.; in order then to obtain 4 horse-power on the propeller-shaft we must have at least 5 horse-power of electric energy to drive our motor. We assume a convenient current, say, of 40 ampères—how many cells will produce the necessary electromotive force?

We have $$\frac{E \times 40}{746} = 5 \text{ H. P.}$$

therefore $$E = \frac{746 \times 5}{40} = 93 \text{ volts,}$$

and, allowing two volts per cell, we require at least 47 cells. We know from experience that the Sellon-Volckmar battery requires only 62·4 square inches of surface (taking the two sides of the plates) for each ampère, so we can readily arrive at the most convenient size and shape of each cell.

(To be continued.)

ON MAGNETO-ELECTRIC AND DYNAMO-ELECTRIC MACHINES.

By J. ANGELO FAHIE, Inst. C.E., Ireland.*

Faraday's Discovery.—In the year 1831 the illustrious Faraday made the important discovery that by moving a coil of wire in the presence of a magnet a current of electricity was generated in the coil, or, *vice versa*, by moving the magnet and holding the coil stationary a like result was obtained, thus a current of electricity was obtained, either by moving a wire in the presence of a stationary magnet, or by moving a magnet in the presence of a stationary wire. The intensity of the current so obtained depended (1) on the strength of the magnetism present, and (2) on the velocity with which the coil was moved through the magnetic field. Upon this simple phenomenon is based the whole of the recent important development in electrical science, and to Faraday we owe the credit of having laid the foundation of the many useful inventions by means of which electric lighting, as well as the transmission of power, and the propulsion of tramcars by electricity has been made practicable to-day.

Now with the knowledge that it was possible to generate electric currents in the manner shown by Faraday, it only remained to devise some mechanical means whereby the different elements which produced the temporary or momentary currents could be combined, so as to collect them, and cause them to flow in rapid succession the one after the other without interruption.

Pixii's Machine.—The first attempt to devise an electrical machine was made by Pixii, who, in the year following the discovery of Faraday, constructed a machine consisting of a permanent magnet, which he caused to revolve in front of the iron cores of a pair of bobbins forming an electro-magnet. We find this invention was considerably improved upon by other workers in the field of science, especially by—

Saxton and Clarke, both of whom succeeded in producing very useful electric generators, in which the mechanical arrangement is the reverse of that in Pixii's—*i.e.*, the magnets are fixed and the coils of wire movable; and it is on this plan all the subsequent machines have been constructed, as affording better results than where the coils are stationary and the magnets movable. The little magneto machines still sold by opticians are constructed on this principle.

Following the inventions of Saxton and Clarke are those of the *Holmes* type, better known as the Alliance machines, which however, are now rarely used in this country, and we shall not, therefore, dwell upon them, but hasten on to the important invention of *Dr. C. W. Siemens*, who, in the early days of magneto electricity, accomplished a great deal towards reducing to practical form the principle of generating electricity by mechanical force. Dr. Siemens' improvement in 1857 consisted essentially in a new form of armature, the construction of which must be familiar to everybody, as, owing to its simplicity and cheapness, it is still used for many purposes, especially for electro-plating and laboratory work. It is composed of a cylinder of iron in which deep longitudinal grooves are cut, resembling in section the letter H. In these grooves is wound lengthwise a simple coil of wire, the two ends of which being joined to a split tube of copper on the axle, forming the commutator from which the current is taken off by brushes or springs rubbing against it. By this longitudinal armature the advantage was gained of cutting the greatest number of lines of force when rotated between the poles of a series of adjacent magnets. The modern armature used in the Siemens machine is somewhat more difficult and complicated in construction, and will be described further on.

A few years subsequent to the invention of Siemens, *Wilde*, of Manchester, hit upon an important improvement by constructing a machine consisting practically of two Siemens' machines combined—a large and a small one; and in the large one he dispensed with the permanent magnets and substituted electro-magnets, which he caused to be excited by the current produced by the smaller one. By this arrangement considerably more powerful currents were obtained than by any of the machines previously constructed.

*Siemens' and Wheatstone's Discovery.**—Next in the order of remarkable electrical phenomena comes the important discovery made simultaneously, but independently, by Dr. Siemens and Sir C. Wheatstone—a discovery which marks the transition of the *magneto*-electric machine to that type most in practice at present—the *dynamo* machine, called for convenience the dynamo. What Dr. Siemens and Sir C. Wheatstone discovered was this:—That a current of electricity could be generated in the coils on the armature by the feeble residual magnetism in the iron cores of the electro-magnets, and that by passing this feeble current round the magnets, their magnetism would be strengthened, which in turn would produce a stronger current in the armature, and this current would again react on the magnets, rendering them more powerful, this action going on until the limit of saturation is attained; for it must be understood that this mutual accumulation cannot go on indefinitely, the magnetism in the iron cores cannot be intensified beyond a certain point, and this point depends on and is controlled by the scientific conditions on which the machine is constructed.

Amongst the several machines constructed on the principle discovered by Siemens and Wheatstone, the most famous are those of Gramme, Siemens, Edison, Brush, Bürgin, and Gülcher. They differ chiefly in the construction of the armature and the arrangement of the electro-magnets. The electromotive force generated in each of them is proportional to the number of turns of wire in the rotating armature, and, within certain limits, to its speed of revolution. Currents of small electromotive force, but of considerable quantity, are obtained by making up the armature of only a few turns of stout wire, or bars of copper (as in the Edison machine), offering only a slight internal resistance. Currents of high electromotive force are produced by forming the armature of many coils of very fine wire and driving it very fast.

The term *electromotive force* may be compared to the pressure of water, being the electric condition necessary to overcome the external resistance of the circuit, just as a given pressure of water is necessary to overcome the resistance offered to its flow—for instance, to move the plunger of a hydraulic press; and as a given quantity of water under pressure is required to keep the plunger moving, so a given quantity of electricity under a given electromotive force is required to keep the lamp burning or the electro-motor moving, as the case may be. The unit of electromotive force is termed a *volt*, which is approximately equal to the force of a Daniell cell; the unit of resistance is an *ohm*, which is the resistance a current experiences in passing through a copper wire 10 feet long by 10 millimetres in diameter; and the unit of current, the *ampère*, which is one volt passing through one ohm in one second of time; or the volt divided by the ohm, and is represented by the equation:—

$$C = \frac{E}{R}$$

C being current, or ampère; E being electromotive force, or volt; R being resistance, or ohm.

Siemens' Modern Machine.—In a suitable frame, powerful, flat electro-magnets are fixed, the upper pair having their north poles facing one another and united by arched pieces of iron, and the under pair having their south poles similarly united. In the space thus formed between the upper and lower magnets the armature rotates, consisting of a cylinder round which are wound longitudinally a number of coils in a peculiar manner and crossing over each other at all angles at both ends of the cylinder, each end of each coil being connected with segments of copper mounted on the axis and forming the commutator. It will be observed that in this machine the two poles of the field magnets act simultaneously on each coil, and the double action operating on opposite sides of the coil, where the current has a contrary direction, the resultant effect is the same.

Edison's Machine.—The next important development which we shall notice in the Siemens type of generators is that of Edison, who has succeeded in applying to practice the largest dynamo yet constructed. Its total weight is about 30 tons (including the engine which is coupled on direct to the armature shaft), and it is capable of 900 ampères. An idea of its colossal size may be formed by com-

* Abstract of paper read before the Inst. C.E. Ireland, and to which we called attention in our "Notes" columns, *vide* ELECTRICAL REVIEW, Dec. 2nd.

* Mr. Fahie, like many others, apparently ignores the claims of Mr. S. A. Varley conjointly with those of Wheatstone and Siemens in regard to the discovery of the reaction principle.—EDS. ELEC. REV.

paring it with the largest Gramme made, which weighs only about one ton, and yields a current of only 90 ampères.

The Edison armature resembles in form that of Siemens, but differs essentially in the method of its construction. The iron core is built up of a number of sheet-iron discs, or washers, insulated from each other and bolted firmly together by bolts passing through them in a line parallel to the axis of the core. This method gives the advantage of a solid iron core, and prevents the circulation of local currents which are usually set up in solid cores, causing a loss of power. Instead of the usual insulated wire the coils are composed of heavy copper bars or prisms, longitudinally arranged, and insulated from each other and from the iron core underneath, and these bars are connected at each end by copper discs of the same diameter as those forming the core. This construction affords very favourable results, and the resistance of the armature is reduced to a minimum, while owing to the annular space between the bars and the core, a free circulation of air is maintained, thereby reducing the tendency to heat and increasing the capacity of the machine. Edison uses long cylindrical masses of metal for his field magnets, wound with only a few convolutions of wire; and by this arrangement he claims to secure a more powerful magnetic-field than by using the same weight of metal of shorter length.

The Paccinotti Type.—In the year 1860, Dr. Paccinotti suggested the use of an iron ring wound round with insulated wire, which he caused to rotate between the poles of permanent steel magnets. The object of Paccinotti was, however, rather to produce an electro-motor-engine, than a machine for generating electric currents; and the advantages of the ring armature remained therefore unrecognised until it found its first practical application in the invention of M. Gramme, of Paris, as introduced and described before the French Academy of Sciences in 1871.

The Gramme Machine is generally considered the simplest form of apparatus for generating electricity by mechanical means. At any rate its action is easily understood. Around the soft-iron ring, which forms the core of its armature, a series of independent bobbins, or coils, are wound, the ends of which are connected to copper plates in such a way as to constitute an endless coil wound in one direction around the ring. The plates are insulated from each other, and so arranged as to form a commutator. This ring is caused to rotate between two powerful electro-magnets, each provided with polar extensions overlapping about two-thirds of the outer periphery of the ring. The magnets are excited by the currents generated in the coils, and the currents flowing from the machine are caught up by brushes or combs which press on the commutator.

The Gramme machine is very popular, and is extensively used both in England and on the Continent.

The Brush Machine.—Closely resembling the Gramme in its general outline appearance, but differing materially in construction and action, is that known as the Brush dynamo, which has recently come into extensive use in the United States and England. For currents of high electromotive force the Brush machine is considered a good one. Its armature, though consisting of a ring like that of Gramme's, is, however, differently "built up." At intervals around the ring a number of transverse grooves are formed, in which are wound the coils or bobbins, all in the same direction; and instead of forming a continuous circuit, as in the Gramme, each diametrically opposite pair of coils are joined to each other by one end of each coil, while the other ends of the pair (*i.e.*, the ends conveying the current) are connected to the commutator in such a manner that a portion of the current flows to the external circuit through one pair of brushes, while another portion of the current is conveyed round the electro-magnets by another pair of brushes. One coil of each pair, in fact, feeds the external circuit, while the opposite coil simultaneously magnetises the field-magnets of the machine itself, thereby strengthening the magnetic-field.

The Bürgin Machine, which is considered a useful and practical form of electric generator, is the invention of M. Bürgin, of Switzerland. Its peculiarity lies in the construction of its armature, which, instead of being a single ring as in the Gramme, is made up of several hexagonal frames mounted parallel to each other on the same spindle, and around each of these frames are wound a series of bobbins or coils as in the Gramme ring. By increasing the number of these frames and lengthening the electro-magnets a higher electromotive force can be readily obtained. This armature is considered very simple in construction, easy of repair, and the coils are easily wound, but the manner of joining them up is somewhat complicated and difficult to explain. The free access of air to the exposed surfaces of the frames prevents the coils being unduly heated by the current. This, at first sight, appears to be an advantage possessed both by the Brush and Bürgin machines over the ordinary Gramme, the armature of the latter being so closely and so thickly wound that it is apt to heat with the current when being driven at a high speed. This advantage is, however, questionable when it is remembered that since the ring in the one case is only partially surrounded with coils, in the other case it is completely enveloped. So that for rings of the same size, and driven at the same speed, the Gramme certainly gives out the greatest stream of electricity. The electro-magnets in the Bürgin machine are traversed in their entirety by the induced currents similar to the Siemens and Gramme machines.

The Gülcher Machine.—The last machine of the purely ring type worthy of note here is that known as the Gülcher, which is a modification of Brush's invention, its armature being somewhat similar in principle and form, with the difference that it is provided with fifty-two sections of wire, and rotates between eight field-magnets—four on each side. It is also provided with a new feature consisting of troughs or shoes, forming three sides of a square fixed round the ring, so that not only the sides of the revolving bobbins are under magnetic influence but also their periphery.

De Méritens' Machine is partly descended from the Gramme and Alliance types, and is the only one at present in use which contains permanent steel magnets, all the other electric generators of recent construction containing the more compact and powerful electro-magnets. In construction the De Méritens' machine consists of a Gramme ring armature, mounted on a spindle and rotated within a circular frame, on which are placed horizontally a series of powerful steel horseshoe magnets on the principle of the earlier form of the Alliance machines. It gives alternating currents, and its coils can be connected in various ways so as to give tension or quantity currents, as may be required. Great efficiency is claimed for this generator, the adjustment of parts is simple and effective, and it is greatly liked by the British lighthouse authorities.

The use of dynamo machines in the generation of electricity for public illumination has now been sufficiently demonstrated to be both practicable and economical, especially in large areas where considerable light is required, such as railway stations, harbours, and public institutions, not to mention lighthouses, in which the electric light has been used with advantage for a number of years; and again in military operations dynamo machines play an important part in producing the intense light required for illuminating at night a distant point to be observed, or lighting up the work of the assailants in sieges. Evidence of their utility in this direction has recently been supplied in connection with the military operations during the late campaign in Egypt.

Next to its importance in the production of the electric light, probably the most useful purpose to which the dynamo has yet been applied is the transmission of power. This property depends on the principle known as the *reversibility* of the dynamo, or, in other words, the transformation of electrical energy into mechanical work, which is simply the converse of what we have been hitherto considering in regard to the means for converting mechanical into electrical energy. In the transmission of power by electricity the current is generated in one machine, from which it is conveyed to another, which may be at any distance, and may be utilised to set machinery of any kind in motion.

The distance over which the electric transmission of power may be carried without serious loss of energy is still a matter of controversy, not having been yet proved by works of any great magnitude. We have it, however, on the authority of Dr. Siemens, as the result of a long series of experiments made by this distinguished electrician, that the total loss resulting from the double process of conversion (*i.e.*, the conversion of mechanical into electrical energy, and secondly the conversion of electrical into mechanical work) is about 20 per cent. To this loss should be added that caused by the resistance of the wires, which depends on their length and sectional area; so that for actual work it is considered safe to assume that the loss sustained over a considerable distance does not exceed 50 per cent., which will not appear very great when compared with the loss sustained in transmitting power by compressed air, water, or other means.

Already tramcars have been caused to run over considerable distances in Berlin and Paris, by electricity transmitted from a stationary generator to one fixed on and coupled up with the axle of the moving vehicle. And in our own country we shall soon, let us hope, have the pleasure of seeing the first really practical attempt of applying successfully and economically the principle involved in the electric transmission of power to a distance. In the electric railway now in course of construction from Portrush to the Giant's Causeway, it is proposed to mount an electro-motor on each car, which will be connected with a stationary dynamo by means of a conductor laid along the rails, the rails themselves forming the return circuit.

It will be a matter of congratulation to the enterprise and scientific genius of Irishmen should this attempt prove successful, it being the first work on a large scale of the kind yet attempted in the United Kingdom.

In conclusion, the author trusted that he has succeeded in imparting some idea of the fundamental principles and construction, as well as of the useful applications of magneto-electric and dynamo-electric machines, through the agency of which, it is not too much to hope that we may live to see the vast power stored up in great waterfalls, in the perpetual flow of our rivers, in the rise and fall of our tides, and in the onward rush of mountain streams, utilised and rendered serviceable to the wants and conveniences of man.

ON THE TRANSFORMATION OF STATIC ELECTRICITY INTO VOLTAIC CURRENTS.

A VOLTAIC current thrown into any given conductor determines by induction a counter-current into a closed circuit which is adjacent and parallel. If we remove the inducing current we obtain in the same circuit a current opposite in direction to the first. If the resistance of the induced current is great enough, the two currents thus produced take the character of tension electricity and may reproduce the effects of ordinary electric machines. This is the theory of the Ruhmkorff coil.

It was therefore natural to ask if the system is not reversible; and if, in other words, on passing the discharge of an ordinary electric machine into the fine wire of a coil we might not obtain in the thick wire an induced current of a very feeble tension and analogous to voltaic currents.

It was only in 1875 that Bichet made his first experiments. With a Holtz machine and a Ruhmkorff coil he was able to decompose water and to deflect permanently the needles of a galvanometer. He stopped here, and whether he did not seize the full importance of his discovery, or that other more pressing researches drew off his attention he did not occupy himself with them further. Professor Goir also sought to transform static electricity into a voltaic current. The announcement of the discovery of the French *savant* caused him to suspend his labours, but he resumed them when he saw that Bichet had laid the question aside.

For the success of the experiment the electrical discharges must be rather strong. Without this condition (which is easily realised by the aid of condensers) the effects of the induced current will be too feeble to be easily observed. Another condition is that the interval between the inducing sparks must not be too great, so that the current may not lose the quasi-continuity which approximates it to voltaic currents.

This current, further, has a character by which it can be readily distinguished. Instead of being truly single and continuous, it is double and discontinuous. When the spark passes into the thick wire it determines an induced current in one direction, and, immediately after the passage of the spark, another current in the inverse direction, but the rapidity of the electric discharge is such that practically these two currents only form one. Another cause of discontinuity is the discontinuity of the inducing sparks. With the exception of these two characters the current behaves in all respects like the currents produced by batteries with liquids.

Its tension is at first very feeble, since it does not give a spark, even on the slightest interruption of the circuit. If the current is put into the acidulated water of a voltameter we obtain decomposition, and, under each receiver, we find a certain quantity of gas. As the current is continually inverted the gas is a mixture of oxygen and hydrogen, the proportions of which vary in each experiment. Perhaps, by suitably regulating the resistance in the induced circuit, we might find the means of eliminating one of the two simultaneous currents, and of thus separating one or other of the gases. If a galvanometer is interposed in the circuit, the needle is not sensibly deflected so long as the circuit does not present a special resistance; but, if we interpolate an interrupter (*e.g.*, Froment's vibrating reed), the needle is suddenly deflected, and this deviation is considerable enough to give a hope of the possibility of utilising the induced current.

If we cause one of the rheophores to communicate with a file and run the other over the teeth of the file we have a train of reddish yellow light like that which we obtain on repeating the experiment with the wet battery. This phenomenon is not that of the spark. It is due to particles of iron and carbon which are detached from the file under the action of the current, become fused or volatilised, and establish thus a kind of bridge between the teeth of the file over which the rheophore is passed.

The two rheophores terminating in very fine carbon points prepared for the voltaic arc are brought in contact. On separating them carefully we see at once a jet of electric light analogous to that furnished by the Gramme machine or the batteries. On repeating the experiment with a conducting wire and a mercurial bath we obtain a luminous arc due to the incandescence of the mercurial vapours. This arc is less bright, but more durable.

This induced current on circulating round a cylinder of soft iron produces rapid magnetisations in two opposite directions which may be shown either by the magnetic spectra obtained with iron filings or by the vibrations of a very light and mobile plate of iron.

Lastly, the most curious experiment of all—the induced current produced in a Ruhmkorff coil by electric discharges may be directed into a second coil like the current of a battery, and determine long sparks with which all the phenomena of the Ruhmkorff coil may be repeated.

Thus the result is a transformation of static electricity into a dynamic current. If with the small Holtz machine which served him as a current-exciter, M. Goir has been able to decompose water, to ignite a bad conductor, and to produce the voltaic arc we may hope by improving the apparatus to obtain powerful electric currents with the machines which produce static electricity, and that with a much less expenditure of force. Perhaps by multiplying, or better insulating, the discharges of atmospheric electricity, we may render ourselves masters of this agent, equally capricious and menacing, and turn it to domestic purposes.—*Les Mondes.*

NEW MODE OF EXPRESSING THE WORK AND THE ECONOMIC RETURN OF ELECTRICAL MOTORS.

M. MARCEL DEPREZ has just presented to the Académie des Sciences two very interesting notes upon this subject, which we shall sum up, regretting that the author thought proper to introduce a new word, the definition of which is somewhat complicated, and which for this reason will not for some time come into general use among industrial and practical men, that is to say, among those whom the question interests most. The theory is applied to the continuous motors of the Paccinotti type.

In a motor in motion there is equilibrium between the motive couple and the resistant couple. Let us suppose the resistant couple to be defined by a weight, F, suspended from a lever equal to 0^m159 (corresponding to a circumference of one metre of development). This couple will be constant whatever the speed of the ring may be. The motive couple, which gives equilibrium to this resistant couple, corresponds in the machine to an expenditure of energy equal to

$$\frac{r\,I^2}{9{\cdot}81} \text{ kilogrammetres per second.}$$

r = resistance of the machine in ohms.
I = intensity of the current in ampères.

This expenditure of energy has the effect of heating the wire, it is constant for a constant intensity, and completely independent of the state of rest or motion of the ring.

A fixed expenditure of energy, which depends on the intensity of the current, corresponds to a fixed motive couple, the resistance of the machine remaining constant. Representing the motive couple by the corresponding resistant couple, F, as we have just defined it, we have—

$$\frac{r\,I^2}{9{\cdot}81} = \rho\,(F). \qquad (1)$$

This power, ρ (F), varies with the arrangement and the absolute size of the motor; it can generally be only determined by experiment. Expressing by R the total resistance of the circuit, the total energy expended in the form of heat is equal to—

$$\frac{R\,I^2}{9{\cdot}81} \qquad (2)$$

We get besides by comparison (1)—

$$\frac{I^2}{9{\cdot}81} = \frac{\rho\,(F)}{r}.$$

Transposing in (2), we have for the total quantity of heat—

$$\frac{R}{r}\,\rho\,(F).$$

Adding to (3) the work produced by the motor, we shall obtain the total work expended by the generator.

Let F_1 and V_1 be the motive couple and the angular speed of the generator.

F and V the resistant couple and the angular speed of the motor.

The absolute work effected by the generator is $F_1 V_1$ per second.

The work produced by the motor is F V per second.

The total heat given off in the circuit is—

$$\frac{R}{r}\,\rho\,(F).$$

We derive from this the equation—

Work expended by the generator.		Total heat.		Work produced by the motor.	
$F_1 V_1$	=	$\frac{R}{r}\,\rho\,(F)$	+	F V.	(3)

And the economic return, K, is expressed thus—

$$K = \frac{F\ V}{F_1\ V_1} = \frac{F\ V}{F\ V + \frac{R}{r}\rho\ (F)} = \frac{V}{V + \frac{R}{r}\frac{\rho\ (F)}{F}}.$$

From the equation (3) we find—

$$F_1\ V_1 = F\ V = \frac{R}{r}\ \rho\ (F).$$

The work lost only depends for a constant couple on the ratio of the resistances, $\frac{R}{r}$. The return, K, depends on three factors. 1st, the speed of the receiver; it increases with it; 2nd, the ratio of the resistances, $\frac{R}{r}$; 3rd, the factor, $\frac{\rho\ (F)}{F}$, that is to say, on the relation of the heat developed in the receiver to the mechanical couple produced by the current. This is the quotient which M. Marcel Deprez calls the *prix de l'effort statique*—the value of the static force.

Practical results. We derive from the consideration of the value of the static force some interesting results from a practical point of view of which we shall give a summary.

The return increases and is nearer to unity for a given speed as $\frac{\rho\ (F)}{F}$ approaches more nearly to zero. The constructor should therefore seek, for a given weight of copper and iron, to vary the relative dimensions of the inductors and of the ring, as well as the mode of coiling the wire in order to diminish as much as possible the value of the static force.

The consideration of the value of the static force shows also that a single motor is better than a combination of similar motors of the same weight taken collectively.

In the second note presented to the Académie des Sciences on the 27th November, 1882, M. Marcel Deprez made known the fundamental experiment which allows of estimating that for a constant intensity the motive couple remains constant whatever the speed of the ring may be.

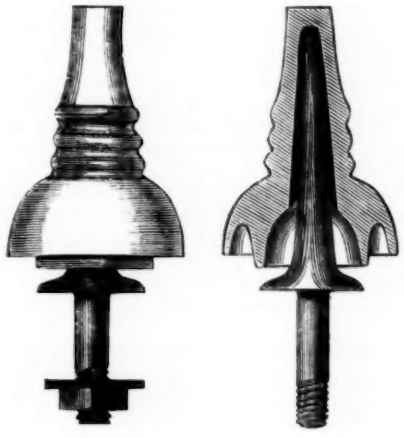
It follows as the last consequence that the difference of the electromotive force developed by the two machines remains also constant. In fact, let E be the electromotive force of the generator, e the electromotive force of the motor, R the total resistance, and the constancy of the intensity gives, by virtue of Ohm's law,

$$\frac{E - e}{R} = I = \text{constant};$$

R being constant, $E - e$ is necessarily so also.

LANGDON'S IMPROVED LEADING-IN INSULATOR.

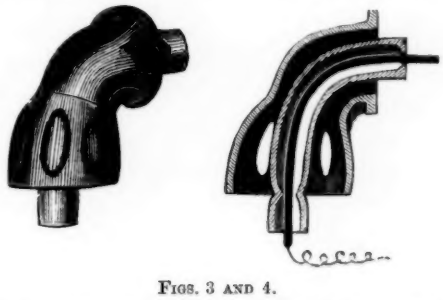
UP to the present time the only form of terminal insulator in very general use has been the Bright's shackle. This arrangement, although mechanically all that can be desired, is electrically very defective, the insulation of a complete shackle termination at its best being but $\frac{1}{8}$th that of an ordinary insulator. The general method of leading the wire into the office from a terminal is also by no means a satisfactory arrangement. Mr. W. Langdon, the well-known telegraph engineer of the Midland Railway, has recently devised a very effective form of terminal insulator, and also an improved leading-in cup, which are decided advances on anything yet brought out. Figs. 1 and 2 show the new form of insulator. It will be seen that great mechanical strength is obtained by carrying the metal bolt a considerable distance up into the porcelain cup, so that the pull of the wire, which would in an ordinary insulator have to be borne by the porcelain alone, is here practically brought to bear on the bolt. By giving a very broad base to the flange of the bolt, the tendency of the whole insulator to become pulled over by the strain of the wire becomes reduced to a minimum. The bolt, it may be remarked, is constructed to withstand a strain of from 1,100 to 1,200 lbs. The insulator is provided with grooves, either of which may be used for the line-wire; but which will also be found particularly useful where copper wire is employed in conjunction with iron, the iron wire in such cases being attached at the lower, and the copper wire at the upper groove, the connection being formed by the ordinary loop. The bolt is of the usual dimensions, viz: to serve the ordinary 2½ in. by 3 in. terminal arm; it can be fitted to the ordinary shackle straps



FIGS. 1 AND 2.

if desired, by slipping a short piece of iron tube over the bolt and between the upper and lower straps, so as to keep the two straps apart.

The "leading-in cup," shown by figs. 3 and 4, is formed by enclosing an insulating tube composed of glass or porcelain in a perforated iron hood. The insulator tube projects at each end, at that nearest the pole for the purpose



FIGS. 3 AND 4.

of embedding it in the pole, and at the distant end that it may, by means of the perforation in the iron hood, become well cleansed by the rain. At a short distance from the mouth of the insulating tube, the space through which the gutta-percha arm is passed is contracted so as to centralise it, and thus keep it from touching the edge of the tube. A felt washer is used between the insulator and the pole. These leading-in cups have been employed for terminations, on "boxing" fixed to ordinary round creosoted poles, as well as on spare poles; in either case they form a very efficient and neat termination.

WRIGHT AND MACKIE'S GLASS BLOWING MACHINE.—We shall shortly place before our readers a full and illustrated description of this invention, which at present is applied to the manufacture of glass bulbs for incandescence lamps. It is a most useful adjunct towards the cheapening of these lamps, and greatly facilitates the rate of their production. Messrs. Wright and Mackie have by means of this machine, and their improved methods of forming the vacuum in the lamp bulbs, rendered a real service to the cause of electric lighting. Their works are being rapidly completed, and in a very short time it is expected that the manufacture of incandescence lamps will be carried on in a most rapid and extensive way. We believe we are correct in saying that Messrs. Wright and Mackie will be prepared to undertake the entire construction of any known system of lamps, and that they do not intend to limit themselves exclusively to any particular form. Doubtless several electric light companies will gladly avail themselves of the new and cheaper process of manufacture devised by these gentlemen.

THE DANDEU-CHERTEMPS DYNAMO-ELECTRIC MACHINE.

IN the ELECTRICAL REVIEW of June 10th there will be found an illustration and short description of this alternating current machine. We then expressed a hope that it would not be long before we could give fuller particulars respecting its efficiency. Until the present time we were not in a position to publish any details of experiments and tests performed with the machine, but we are now enabled to bring before the notice of our readers two reports on the Dandeu-Chertemps system, compiled by Mr. Robert Sabine, C.E. We may remark that the report dated June of the present year deals with the *first* machine constructed and sent into England, it being constructed solely for use with Jablochkoff candles, and differing in many details of manufacture from the later machines which form the substance of Mr. Sabine's subsequent report dated December, 1882.

COPY OF MR. ROBERT SABINE'S FIRST REPORT.

I have examined the dynamo-electric machine of Messieurs Chertemps & 'Dandeu, with the following results. I found the machine, which is designed to sustain ten Jablochkoff lamps, to be very compact and well made. It is on the alternative current principle, and self-magnetising. Its inducing coils are made to rotate, while those of the induced circuit are stationary, an arrangement which greatly facilitates any necessary supervision or manipulation of the main circuit while the machine is in motion. The supporting frame of the induced bobbins is constructed entirely of insulating material for the purpose of avoiding the development of the so-called Foucault currents, and this is unquestionably a means of saving engine-power and working the machine more economically than would otherwise be the case.

Photometric measurements were made with 2 up to 8 Jablochkoff lamps in circuit, when the machine was driven by a 4 (nominal) horse-power steam-engine, of which indicator diagrams were simultaneously taken, and it was found that the power expended in the machine, short conductors, and lamps increased as follows:—

Lamps on circuit.	Engine-power expended on machine, leads, and lamps.	Speed of machine.
2	1·28 horse-power	1,150 revolutions per minute.
4	2·27 ,,	
6	3·60 ,,	
8	4·25 ,,	

The average illuminating power of the lamps was 323 standard candles (actual) during these measurements.

Similar measurements with ten Jablochkoff lamps and upwards in the circuit were made with the aid of a 20 (nominal) horse-power steam-engine, which enabled a greater velocity of rotation to be steadily maintained.

When ten lamps were in circuit, the machine being driven at 1,226 revolutions per minute, the engine-power expended in machine, leads, and lamps was 5·65 horse-power, the average illuminating power per lamp being 430 standard candles (actual) or an effective equivalent of 762 standard candles (actual) per horse-power expended, which is as high as can be expected for a small machine.

The light given by the lamps was remarkably steady, and the carbon rods were consumed very uniformly.

At the desire of the inventors as many as 16 Jablochkoff lamps were at one time introduced into the circuit and burnt steadily; while 14 lamps were burning the average illuminating power was found to be 388 standard candles per lamp. The machine after being at work for two hours did not show any signs of heating, so long as the number of lamps did not exceed 10. But when 16 lamps were sustained the stationary induced magnets became after awhile heated, the rest of the machine and the moving bobbins remaining cold. I conclude from this that not more than 12 Jablochkoff lamps, each giving a light of about 400 standard candles (actual) could be safely worked continuously by this little machine.

The commutator which directs the currents from one of the stationary electro-magnets into the magnetising circuit, works against the brushes perfectly free from sparks.

In the foregoing tests the coils of the machine and the lamps in circuit were connected up in series.

The terminals of the machine are, however, arranged so that the current of each induced bobbin may, if required, be connected so as to actuate a separate and independent lamp circuit.

A very ingenious arrangement is employed for short-circuiting each of the induced bobbins by the armature of a small electro-magnet which falls upon the terminal blocks in the event of a rupture of the outer lamp circuit.

In point of cost I should say that this machine would certainly be the cheapest I have seen capable of keeping an equal number of lamps in action.

Yours faithfully,

(Signed) ROBERT SABINE.

7, GREAT WINCHESTER STREET BUILDINGS,
LONDON,
E.C.
5th December, 1882.

CHERTEMPS' DYNAMO MACHINES.

DEAR SIR,—I have, at your request, tested two of the Chertemps machines which you have at Charles Street, Hatton Garden.

In reply to the questions asked in your letter to me of the 24th November, I beg to say that:—

1. I find the smallest machine (alternating current) keeps twenty Edison A 16-candle lamps incandescent at an expenditure of about 2 horse-power as indicated by M. Morin's dynamometer which is placed between the steam-engine and the machine.

The maximum number of lamps which I saw in circuit at one time was twenty-five, which number was then reduced by five at a time. The horse-power indicated by the dynamometer fell each time proportionally to the number of lamps removed from the circuit.

2. The medium-sized machine, when giving alternate currents with its induced bobbins parallel, was put in circuit with 52 Edison A lamps, which were kept incandescent at an average of 17·5 candles with an expenditure of 6·2 horse-power indicated by the dynamometer. The machine was afterwards connected up so as to give continuous current, the same number of lamps being kept incandescent at an average of 15·1 candles per lamp, while the indicated horse-power was 5·1, showing that in so far as lighting power goes circuits with alternate and continuous currents generated by the same machine give much the same result. In each instance over 80 per cent. of the power given to the dynamo machine was accounted for electrically, and over 65 per cent. was accounted for in the lamps alone.

3. The same machine, with its induced bobbins in series and giving alternate currents, was then connected with and kept in action ten Jablochkoff lamps, also in series, at a total expenditure of 4·9 horse-power indicated by the dynamometer as being given to the dynamo machine. The number of lamps was changed by two at a time and, the difference of the power given to the machine being observed at the dynamometer, it was seen that the power employed was always proportional to the number of lamps in circuit, the machine regulating this automatically. When maintaining the Jablochkoff lamps about 80 per cent. of the power given to the dynamo was accounted for electrically, and with over four lamps in circuit about 65 per cent. was accounted for in the lamps alone.

I consider that, having regard to their size and weight, the efficiency of these dynamo machines both for arc and incandescent lamps is very satisfactory.

I enclose the details of the tests made with the larger of the two machines.

Yours faithfully,

ROBERT SABINE.

R. APPLEGARTH, ESQ.,
Mansion House Chambers, E.C.

CHERTEMPS' (MEDIUM-SIZED) MACHINE TESTED WITH 52 EDISON A LAMPS (FRENCH-MADE) CONNECTED PARALLEL WITH SHORT LEADS.

	Alternate Current.	Continuous Current.
MAIN CIRCUIT (external):—		
Current per lamp	$0·68a$	$0·66a$
,, for 52 lamps, c	$35·4a$	$31·3a$
Potential difference, e	85v	83v
Horse-power accounted for in 52 lamps... ... $\left\{ \frac{c\,e}{746} = w \right.$ ...	4·03	3·48
MAIN CIRCUIT (internal):—		
Current (as before), c	$35·4a$	$31·3a$
Resistance of 5 bobbins parallel, r ...	$0·3\omega$	$0·3\omega$
Horse-power accounted for in internal wire ... $\left\{ \frac{r\,c^2}{746} = w_1 \right.$	0·50	0·39
MAGNETISING CIRCUIT:—		
Current in magnetising circuit, c_1 ...	$6·5a$	$6·5a$
Resistance in magnetising circuit, r_1 ...	$7·4\omega$	$7·4\omega$
Horse-power accounted for in this amount ... $\left\{ \frac{r_1\,c_1^2}{746} = w_2 \right.$	0·42	0·42
Speed of dynamo, rev. per min.	1,180	1,174
Pull on dynamometer, k	49 kilog.	45 kilog.
Speed of dynamometer, rev. per min., s ...	662	648
Indicated horse-power $3·21\times10^{-4}\,s\,(k-20) = W$	6·2	5·1
Horse-power accounted for electrically, $(w\times w_1\times w_2)$	4·95	4·29
Proportion of horse-power electrically accounted for $\left\{ \frac{w\times w_1\times w_2}{W} \right.$	0·80	0·84
Proportion of horse-power accounted for in lamps alone ... ... $\left\{ \frac{w}{W} \right.$	0·65	0·68
Horizontal (front) candle-power of one lamp (average)	17·5	15·1

CHERTEMPS' (MEDIUM-SIZED) DYNAMO MACHINE TESTED WITH JABLOCHKOFF CANDLES CONNECTED IN SERIES.

Number of lamps in circuit, n ...	10	8	6	4	2
I. MAIN CIRCUIT.					
Current in ampères, c	5·5	5·5	5·3	5·0	5·0
Internal resistance in ohms, r ...	7·3	7·3	7·3	7·3	7·3
Horse-power accounted for internally $\frac{c^2 r}{746} = w$	0·30	0·30	0·27	0·24	0·24
External potential-difference of lamps, volts, E	430	344	258	168	88
Horse-power accounted for in lamps $\frac{E c}{746} = w_1$	3·16	2·53	1·93	1·15	0·60
II. MAGNETISING (FIELD) CIRCUIT.					
Current (ampères), c_1	5·4	5·0	4·6	4·1	3·7
Resistance of wire (ohms), r_1 ...	7·4	7·4	7·4	7·4	7·4
Horse-power accounted for in field circuit $\frac{c_1^2 r_1}{746} = w_2$	0·29	0·25	0·21	0·17	0·14
Speed of dynamo	1,242	1,230	1,236	1,260	1,218
Pull on dynamometer in kilog., k	42	36	32	28	24
Speed of dynamometer, revolutions per minute, s	665	666	678	676	678
Indicated horse-power, $3{\cdot}21 \times 10^{-4}\ s\ (k-19) = W$	4·9	3·7	3·0	2·0	1·2
Horse-power electrically accounted for, $w \times w_1 \times w_2$	3·75	3·08	2·41	1·56	0·98
Proportion of horse-power electrically accounted for	0·77	0·83	0·81	0·78	0·81
Proportion of horse-power electrically accounted for in lamps ...	0·64	0·68	0·64	0·57	0·50
Horizontal front candle-power of one lamp*	289	334	321	308	279

On Tuesday evening last we had an opportunity of seeing two of these alternating current machines in action at 35, Charles Street, Hatton Garden, where they were shown under the auspices of Messrs. Applegarth and Wills. The small machine was joined up with 20 incandescence lamps and Mr. Applegarth disconnected them one by one until only a single lamp was left, which, however, did not increase perceptibly in brilliancy, although the machine was running at the same speed all the time. This however is easily understood in such a construction of machine, the lamps being connected in multiple arc. That which is not so easy to explain is the proportionate automatic regulation of the machine for work to be done when connected up with Jablochkoff candles in series. It would be a very interesting matter to construct a Dandeu-Chertemps machine weighing, say, 12 cwt. complete and compare its efficiency with that of the recently exhibited "Ferranti." The machine which kept the 52 Edison lamps in action is very small and its weight cannot be much, but we could not get any definite information on this point. In regard to Mr. Sabine's tests we can only draw attention to the fact that the Morin dynamometer may or may not have given accurate results. However, we have no reason to doubt its correctness and only draw attention to it as a *possible* item of uncertainty. As far as we can judge at present the Dandeu-Chertemps system, the principle of which is of course common to many machines, appears to have a promising future before it and as far as merit goes should command success.

PERSONAL.—It may interest our readers to know that Messrs. H. and E. J. Dale, the well-known electrical instrument makers, have succeeded to the business so long carried on by Mr. F. J. Cox, of 26, Ludgate Hill. This extensive addition to their already considerable premises will enable them to keep in stock, ready for immediate use, the largest collection of electrical apparatus in London. In addition to this they will keep a most complete assortment of photographic, optical, chemical, &c., materials and appliances. The Messrs. Dale have now three establishments: the one above-mentioned, 3A and 4, Little Britain, and 9, Kirby Street, E.C. They have established a dynamo-electric machine factory at the latter place. Messrs. Dale notify that with the resources now at their command they intend to keep in the forefront of scientific industry. We wish them every success.

* The carbons used in these measurements were apparently of inferior quality.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Letters, &c., for the "Correspondence" columns should arrive not later than Tuesday morning if they are desired to appear in the following number, such communications to be addressed to the "Editors," ELECTRICAL REVIEW, 22, Paternoster Row, London, E.C.

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CORRESPONDENCE.

THE PATENT ELECTRIC GAS IGNITING COMPANY.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—While acknowledging the public spirit and the laudable motive which has led you to the criticisms in your issue of the 9th inst. upon the prospectus of the "Patent Electric Gas Igniting Company, Limited," I cannot help thinking that these are based solely upon your perusal of the prospectus, and not upon an examination of the different apparatus and patents acquired by the company. You will agree with me that on the value of these alone will depend the correctness of the anticipations set forth in the prospectus, and whether the statements contained therein are exaggerated or not.

From intimate knowledge of the construction of the electric gas lighter and experience of its appreciation by the public hitherto, I can substantiate the truthfulness of the advantages enumerated, and can see no reason to doubt the general soundness of the predicted success so confidently stated.

You yourself acknowledge that many others have tried to produce contrivances for gas lighting by electricity, which goes to prove the existence of a public want in that direction, and your principal strictures appear to arise from the hitherto lack of success of such attempts. Now I can affirm that Clarke's patent gas lighter is in every way, scientifically and commercially, a success, and fulfils completely all requirements, and as a proof of this, I may say over 10,000 have, within a very short time, been sold in the Manchester district alone, and that the demand exceeds the supply by as many thousands more. As the lighter is already being extensively sold, your readers have an opportunity of examining its construction for themselves, therefore I need not enter into detail, but referring to your statement, which I fully endorse, regarding the form of the battery and coil, I am not aware of any possible combination of existing batteries and coils that could be used for the same purpose. However, the company is not dependent on the manufacture of these lighters alone, but the battery itself and the particular construction of the coil are applicable and useful for so many different electrical purposes that I con-

fidently anticipate unprecedented results for the company from the manufacture and sale of these two items solely.

On the value of the battery as such the company have the most flattering testimony from such eminent electrical authorities as Sir W. Thomson, Messrs. Preece, De La Rue, &c., it being small, constant, hermetically sealed, portable, and producing no internal action when not in circuit, therefore well adapted for telephones, bells, medical and testing work, &c., and facilitating the more general adoption of electrical appliances by the public.

The coil, from its exactness and cheapness, will recommend itself to the notice of electrical instrument makers.

As to the chances of profits arising to the company from the sale of concessions and foreign patents, if what I have stated above is true, the business in England must, with good management, succeed, and then it cannot be difficult to dispose of these to the advantage of the original shareholders. While, for the company itself, I can say from personal acquaintance that with such a directorate and manager, whom I have found to be thorough men of business and gentlemen far too scrupulous to insert in a prospectus anything not entirely in accord with their conviction, good management is assured.

So convinced am I of this that I have identified myself with them both as a shareholder and as the chief contractor for the general sale of their manufactures, and I shall always be happy to give all information regarding these to any one interested.

Feeling sure that you would not willingly impede, but rather are eager to promote, the general adoption of electricity to all useful purposes, I trust you will not consider this letter too great an encroachment upon your valuable space.

Thanking you, I am, dear Sirs,

Yours truly,

G. BINSWANGER.

29, Aldermanbury, E.C., *December 11th*, 1882.

[In reply to our correspondent's arguments in favour of the above company, we may say that we have examined one of Clarke's patent gas igniters, and we think that as far as its purpose goes it is quite a success—indeed, we have never seen anything so good before. We have yet to learn that the conviction of a directorate necessarily means the success of a company's operations; in fact, we have too many proofs to the contrary. We should be pleased to feel that the sanguine anticipations of Mr. Binswanger would be carried out, but we do not think it incumbent upon us to withdraw any of the remarks contained in our article or to comment further on the matter.—EDS. ELEC. REV.]

THE B. T. K. SYSTEM OF ELECTRIC LIGHTING.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—I should be obliged if you or one of your many correspondents would assist me by explaining the following difficulty which occurs to me respecting the B. T. K. system of incandescent electric lighting:—We know that incandescent lighting requires a current of low tension and great quantity. Then how is it that in the above system a Brush arc machine, producing a current of high tension and low quantity, is used to charge a reservoir composed of secondary batteries connected in series? Does the current undergo a change of nature in course of accumulation, and the charge emitted possess the properties of an incandescent current? It appears to me necessary that it should do so in order to produce incandescence without breakage. If so, how, and by what agency?

Yours truly,

December 7th, 1882. R. A.

[To charge secondary batteries in series we employ a dynamo-electric machine of greater electromotive force than the combined secondary cells possess when fully charged. For instance, if we had to charge 150 cells in series, we should make use of a machine having an electromotive force of considerably more than 300 volts, as each cell represents something over 2 volts when charged fully. Our correspondent will quite understand that the charging battery or machine must be more powerful than the receiver, otherwise in a certain time the latter would have an equal electromotive force with the former, and would, therefore, oppose any further charge. There is no such term as an "incandescent current." The amount of current passing in any circuit depends upon the resistance of that circuit and the electromotive force of the generator. If "R. A." connected up 20 Swan lamps (of the 41 volt and 18 candle-power type) in multiple arc, he would require a machine wound to give 41 volts or a trifle more, and a current of 26 ampères, which divides in 20 parts through an external resistance (lamps) of 1·57 ohms. On the other hand he might connect the 20 lamps up in series, and it would then be necessary to wind a machine to give 820 volts, or thereabouts, electromotive force, and a current of 1·3 ampères through an external resistance (lamps) of 630 ohms. The lighting effect would be the same in both cases.—EDS. ELEC. REV.]

THE BRUSH COMPANIES AND THE LANE-FOX LAMP.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—I think your article in this day's Review on "The Brush Companies and the Lane-Fox Lamp" is a very fair statement of the case. The position of the shareholders in some of those companies I take to be this:—

We ventured on the faith of plausible prospectuses to invest in property we did not understand, and we paid the prospectus-makers, who did understand it, large sums for certain concessions. So far, good. We made a bad bargain and we must be prepared to abide by it; but in due time it turns out that the other side have sold more than they are able to convey. Are we not then fairly justified in reconsidering the transaction and rescinding the entire contract? If I contract to purchase two houses for one sum, but find the title to one of them is bad, I cannot be compelled to take the other, though I may claim damages for the breach of contract.

With regard to the tabular statement annexed to your article and "compiled from official returns at Somerset House," I would point out that as regards the Yorkshire Brush Company it is very misleading. The capital issued is not £200,000, as only 61,633 two pound shares have been issued, including 25,000 to the vendors "considered as paid." This was admitted by the chairman at the meeting on November 15th, reported in the ELECTRICAL REVIEW of the 18th. Again I find under "calls paid" £122,943 10s., but this also includes shares considered as paid, for the chairman admitted (*vide* your report) that after settlement with the vendors there was only a capital of £23,000 to go on with.

It appears to me that "The Companies Acts" require further amendment in many particulars. Is it not absurd to publish official returns of "capital issued" as so many hundred thousand pounds, simply because that amount has been offered to the public?

Yours obediently,

A SHAREHOLDER.

December 9th, 1882.

THE ELECTRIC LIGHTING ACT.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—The remarks lately made by Mr. Chamberlain as to the Board of Trade's action touching Electric Light are certainly in favour of companies desirous of showing what they can do, enabling them to spend their (in many cases) too easily obtained capital without parish assistance, in the shape of a contract to light the principal thoroughfares of the district. Most of the new light companies will labour under considerable disadvantages, and I would strongly advocate their not acting hostile to, but running concomitant with the vestry authorities. There is no doubt that in the event of several companies applying to a parish for "permission," those who have to decide cannot fail to be (using a word most applicable at this time) fogged. Again, to cater for the illumination of an entire district may, in many instances, be more than the funds of a company can well stand, looking to the fact that they are in all probability carrying on good work elsewhere. Now would it not be better for the local authorities to closely scrutinise the systems, making up their minds to adopt for their own lighting, say, one system in the wider and

larger streets of the parish; another mode, where the areas are spacious and extensive; and a third, if practicable, where lanes and narrow streets have to be dealt with, in each and every case, allowing the company installed to provide private lighting in the section of the parish where they have laid their cables? It might happen that the proprietors of a system selected by a vestry for adoption in a part of the district might decline to entertain the proposal, in which case the authorities would have to select another and the company reserve their money for what they might consider a better installation.

Taking a survey of the various systems now before us and under what circumstances the best of them would be the proper light in the right place, I might be allowed to suggest, for large open spaces and lofty railway stations, if not too expensive, "Siemens," not, however, pitching the poles as high as in the late City trials; if the price forbids, "Brockie," if he will behave better and not hum so much.

For long roads where good lighting is required, appearance or uniformity not being a desideratum, perhaps no better lamp than "Weston."

For streets where uniformity and neat and trim appearance are required, "Jablochkoff"; this also, I may say all round, is for every purpose, in or out of doors, the best "arc" lamp.

For narrow streets and lanes, having the lamps swung across the streets, fixed to a bar placed high up, a "Pilsen" or a "Brush" might be employed. I have thus very roughly gone over a few of the best arc lamps, leaving entirely out of account incandescent globlets: they are really, in street or public lighting, not so good as gas; only in small rooms do they score. For outside illumination, which we require to be of a better description than at present, the use of an incandescent lamp is *not* an improvement. Most of the arc companies above-named, in the portions of the parishes or districts allotted to them, would be able, no doubt, to introduce the incandescent lamp they thought best suited; by some such plan capital would, I think, be saved; no unnecessary laying of wires need take place, and the vestries would have an opportunity, if they had more than one system installed in their district, of judging which did the work best, and which was most reasonable. The term of years at first accorded, and it ought not to be less than three, having expired, they would be enabled to decide which for the future was to be the "parish lamp."

Before concluding, a few words touching fogs.

This, in the future of electric lighting, is a serious question. The ever-handy servant, gas, has only to be turned on, and in foggy weather our darkened residences, or places of business, become bright and cheery. With electric light it is a more difficult matter. Steam-engines and dynamos have to be set in motion. True, if accumulators are ever perfected, a store of electricity will be to hand, to turn on when required. In these, our seemingly ever-increasing darkening winter days, there is to be considered what system in lighting by the new method is best adapted for fog. In most the blue or yellow ray predominates. Such in thick fogs are hardly visible; the red ray alone permeates the thick and cloudy atmosphere, and perhaps for such "Jablochkoff" stands best adapted. Many months ago, when fogs hung thick on the banks of the Thames, and when other systems were in the streets, hardly more discernible than gas, I have, in my rambles, often noticed the lamps on the Embankment clear and distinct at over fifty yards. The gas lights could not be seen until at the lamp-post one had arrived, while standing at the foot of a Jablochkoff lamp, one distinctly saw the next, with a "halo" of the one succeeding. Perhaps some of your able scientific correspondents will give us their views on this most interesting subject.

In the use of electricity as a lighting medium in comparatively clear weather we go on steadily improving. Still we have, in this our fog-girt isle, yet to discover by what means, or by what chemical introduced into the electrodes, the proper ray can be developed, so as to show through fog, thereby assisting us in lighting when necessary our streets, and protecting our noble sailors when in foggy weather approaching our iron-bound coasts.

ELECTRON.

ELECTRICAL ENGINEERING CLASSES.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—No doubt you are still desirous of further opinions of students respecting the results to themselves of the lectures in electricity at the City and Guilds of London Institute. I regret that my experience should conform so closely to that of "F. W. F." and "Sea Boots," and I consider that the tone of Mr. Cockburn's answer in yours of the 2nd inst. confirms "Sea Boots'" complaints as to the courtesy (?) of the assistants.

No doubt in the present crowded state of the laboratory it is difficult to find room and patience for all; nevertheless, I think that the insinuation as to the method of relief put forward by Mr. Cockburn in the last sentence of his letter comes with questionable taste from a paid official in a subordinate position, and is deserving of resentment by the students, and ought to be rebuked by his superiors.

Much depends on the attention given by the Professor and the Demonstrators in the laboratory, but it seems to me the want of this, and the almost entire absence of organisation and system, and not the overcrowding, are the cause of the admitted failure of the laboratory experiments, for I have noticed the same difficulties when only a small number of students happened to be present.

The lectures themselves I feel a reluctance to criticise but my own opinion is that the whole cause suffers for want of a well-considered syllabus at the outset, and the lectures individually appear deficient in careful preparation, but above all I question whether the professor pays sufficient attention to the different states of advancement which must exist in so large a class.

This is noticeable when at rare intervals, after filling the blackboard with figures and formulæ, he inquires if all have understood him. The hesitancy in replying to this inquiry (often not one of the hundred present ventures to put a question or seeks an explanation) shows either that all thoroughly understand it, or that the majority have failed to grasp the gist of the Professor's remark. I should like to take a poll of my fellow students as to which is the correct interpretation of their silence. Let us hope that when the larger building is ready improvements in organisation may be inaugurated which will materially reduce these difficulties as well to the Professor and staff as to the students; otherwise I fear that the "many thousands of pounds" alluded to by Mr. Cockburn will fail to yield the full return expected by the givers.

I would, lastly, offer the suggestions that the new building should be provided with an efficient reference library of standard works and the laboratory amply furnished for the use of the students, with models of telegraph and telephone instruments, and of the different parts of dynamos and lamps, of which now there is a great paucity.

Yours faithfully,
ONE WHO WISHES TO LEARN.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—Having read with interest the information in your journal concerning electrical engineering classes in London, I venture to ask you for any information you could give me concerning the School of Telegraphy and Electrical Engineering (Prince's Street, Hanover Square). I write specially on behalf of a friend who is thinking of entering as a student. According to their advertisements and prospectus, this school would appear to be all that could be desired, but I should be much obliged if among your subscribers any former student would kindly give his experience, especially concerning the questions so aptly put in your issue of November 18th.

I take this opportunity of writing to you to ask if you could give me information concerning the method or methods of rendering a watch unaffected by magnetic influence; perhaps you could quote some back number of the ELECTRICAL REVIEW where I should find this. Does it consist in the substitution of some non-magnetic metal for the steel springs and bearings? I enclose my card, and

Remain, Sirs, yours truly,
December 12th, 1882. OLD SUBSCRIBER.

[Our correspondent's surmise in his last paragraph is, we believe, correct.—EDS. ELEC. REV.]

THE TELEPHONE PATENTS.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—The enclosed correspondence may be of interest to the public.

Messrs. J. T. Gent & Co., on the receipt of the following letter from the solicitors of the United Telephone Company, were released by me from their contract to make the Lockwood-Bartlett telephones, and at once cancelled their orders for materials to make them, because I was unwilling that their business should be injured by any action the United Telephone Company might take in their attempt to prevent the public from having the benefit which must arise from competition. The Lockwood-Bartlett telephone will be offered to the public by the Molecular Telephone Company of New York, and that company, with a fully paid-up capital of £200,000, will be ready and able to defend its patent rights.

Yours truly,

December 14th, 1882. W. C. BARNEY.

From WATERHOUSE and WINTERBOTHAM, Solicitors.
1, New Court, Carey Street, Lincoln's Inn, W.C.
29th November, 1882.

GENTLEMEN,—Your letter of the 24th inst. addressed to the United Company has been handed to us to reply to.

We have not seen the telephone which you term the "Lockwood-Bartlett," but if it is a magneto instrument operating upon the principle of Bell's instruments as we are given to understand, it is, in our opinion, an infringement of our clients' patent rights.

We have never seen a carbon transmitter operating successfully without a diaphragm, and we would refer you to the judgment both of Lord McLaren in the case of the United Telephone Co. *v.* McLean, and of Mr. Justice Fry in the case of the United Telephone Co. *v.* Harrison, Cox-Walker & Co., as showing what, in the view of the court, constitutes a diaphragm.

We are not, therefore, prepared to admit that this instrument is outside the Edison patent, nor, indeed, that it would be so even if it had no diaphragm at all.

Our clients will take such proceedings as they may be advised in the event of the continued sale of these instruments.

We are, gentlemen, yours obediently,
WATERHOUSE AND WINTERBOTHAM.

Messrs. J. T. GENT & Co.
Faraday Works, Leicester.

7, BRIGHTON VILLAS, PRINCESS STREET,
LEICESTER, *December 2nd*, 1882.

GENTLEMEN,—Your letter of 29th ult., addressed to Messrs. J. T. Gent & Co., has been handed to me. A more extraordinary document emanating from gentlemen "learned in the law" has never till now been my lot to read; you write "we have not seen the telephone Lockwood-Bartlett," and from your own imagination or from hearsay, you build up a hypothetical case, and then you have the cool assurance to use threats against Messrs. J. T. Gent & Co., manufacturers, under contract with the Molecular Telephone Company of New York, to make the very excellent Lockwood-Bartlett telephones. Your combined legal minds have no doubt suggested to your clients the danger they would incur if they should write such a threat, and you, their legal advisers, prepare a shield for your own justification by qualifying your threat with that important little word "if."

Your opinion that the Lockwood-Bartlett instrument is an infringement of Bell's instrument may be highly valued by your clients, but as you admit you have not seen the instrument of Lockwood-Bartlett, I hope you will not think me discourteous when I say your opinion has no weight whatever with me, nor do I believe it can have any weight with any one.

In order that you may examine the excellent Lockwood-Bartlett telephone, I have requested Messrs. J. T. Gent & Co. to send you one of these telephones.

These conscientious gentlemen, before they agreed to manufacture the L. and B. telephones, took great pains to examine critically the construction of this instrument, and to compare it with that of the Bell telephone.

They had before them the opinions of Cromwell F. Varley, F.R.S., and of Sir Charles T. Bright; both of these eminent electricians gave opinions that it is not an infringement of Bell's patent; they had also the description of Bell's invention by Sir William Thomson, given under oath, in the suit of the United Telephone Company *v.* Harrison, Cox-Walker & Co., to which case you refer Messrs. J. T. Gent & Co., which description is in the following words: "the most important part of the new invention is the fixing of the vibrating iron plate all round its edge, that is a most important part, perhaps the most important part of all;" "the disc held at one point of the edge was made known before the date of this patent, and the new invention included the substitution for the disc held at one point, of a disc held all round its edge;" they, however, mainly relied upon the description of Bell's invention given by Mr. Justice Fry in his clear judgment, which is in these words: "Bell's invention, as claimed by him, and as I understand it, consists of a horse-shoe magnet, the ends of which are brought into the circuit by means of coils of wire, and in front of which is a metallic plate capable of inductive action, placed at right angles to the length of the magnet, resting, as regards its circumference, on the wooden case."

These gentlemen did not find in the Lockwood-Bartlett a *metallic plate capable of inductive action* placed at right angles to the length of the magnet resting, as regards its circumference, on the wooden case, but they did find a *free tongue*, as used by Reis, and as used by Bell in his famous Glasgow receiver, and as described by Bell in his United States patent of March 7, 1876, and also in Bell's English patent of December 9, 1876. I refer to the telephonic apparatus with the gold-beater's skin, which is represented in the drawings of Bell's patent, figure 19. Unfortunately for your clients that description was published in England prior to December 9, 1876, and therefore it became necessary, in order to save his patent, to disclaim that device by a disclaimer filed on the February 13, 1878; and also the Glasgow receiver, which was never patented by Bell in England, was made public prior to the December 9, 1876.

The right to use a *free tongue* in a telephonic instrument in *combination* with an *electro-magnet* is, therefore, unquestionable. Mr. Justice Fry in his judgment used the words, "it appears to me to be plain that the armature in Reis's receiver was not a disc at all, it was not a plate at all, and there is nothing in the Reis which can be considered to have been an anticipation of the armature of the description indicated in Bell's patents;" hence it follows that the Bell patent does not cover a *tongue armature*.

In reply to your hypothesis that a magneto instrument, operating upon the *principle* of Bell's instrument, is, in your opinion, an infringement of your client's patent, I must confess that I am ignorant of that part of the Patent law which allows a *principle* to be subject-matter for a patent, and I shall be pleased if you will enlighten me on this point. It seems to me that it was unnecessary for you to use a *hypothetical case* upon which to make your threats against Messrs. J. T. Gent & Co., as you could have obtained a copy of Lockwood-Bartlett's patent from the Patent office, or from the general manager of the United Telephone Company, to whom I gave a copy in March, 1881, and who was well acquainted with the Lockwood-Bartlett receiver, one of which he tested in my presence at the offices of the company on the 16th March, 1881, and by his instructions it was tested by his employés, on several occasions, at the company's offices in Chancery Lane and Westminster, with excellent results.

Although I have no interest whatever in the excellent transmitter of Messrs. J. T. Gent & Co., you will pardon me, I hope, if I submit a few remarks upon that part of your letter wherein you write, "We have never seen a carbon transmitter operating successfully without a diaphragm." Surely the fact that *you* have never seen such a transmitter is no evidence that no such transmitter is in existence. Now, in order to enlighten you on this point, Messrs. J. T. Gent & Co. will send you one of their transmitters, wherein you will *not* find a diaphragm, nor the semblance of one, as is clearly proved by the judgment of Lord McLaren and Mr. Justice Fry. You will find that this transmitter *without* a *diaphragm* is a remarkably good one, and you then *perhaps* may be convinced that it is outside the Edison patent, although I cannot expect that you will admit it, as you write, "you are not prepared to admit it even if it had no diaphragm at all." Here comes in what you must excuse me for terming the ridiculous part of your letter.

Edison's single claim left out of his original thirty odd claims is for "the combination with a diaphragm, or tympan of electric tension-regulators substantially as hereinbefore described." These are the essential parts of his invention, the *combination* of the two parts are covered by the patent, but the use of either of them alone certainly is outside the patent.

It is indisputable that the specifications must describe the nature of the invention in an intelligible manner, so that a person of ordinary acquaintance with the subject-matter could understand it.

I now put it to you, could any mechanic skilled in the construction of telephones make a Lockwood-Bartlett receiver from the description of Bell's telephone given in the specification of the patent, or could a mechanic make a Bell telephone from the description of the Lockwood-Bartlett telephone as given in his patent, No. 2,419, June 10, 1880? The Molecular Telephone Company of New York, who are the owners of the Lockwood and Bartlett patent, will take such proceedings as they may be advised to protect their patent rights, as well from *libel* as from infringement, and also to protect their manufacturers from intimidation by threats or otherwise.

I am yours obediently,
W. C. BARNEY,
Agent for the Molecular Telephone Company of New York.

Messrs. WATERHOUSE & WINTERBOTHAM, Solicitors,
1, New Court, Carey Street, London.

POPULAR LECTURE ON ELECTRIC LIGHTING AND THE ELECTRIC TRANSMISSION OF POWER.—Mr. A. Reckenzaun, C.E., lectured on Wednesday evening before a crowded house in the new and spacious Limehouse Town Hall. After some historical remarks the production of electric currents by wire coils in magnetic fields was illustrated; and various forms of arc and incandescent lamps were shown in operation. The main feature of the evening, however, was the Sellon-Volckmar accumulator, which gave remarkable proofs of its utility. One set of cells, 30 in number, served for the arc lamps, all kinds of incandescent lamps, and finally for driving several motors; the collection of small motors in action consisted of a Griscom, the Howe motors, De Méritens' electro-motors, C. type, and a motor of Mr. Reckenzaun's own design. Mr. Percy Mills assisted in the experiments, and the whole proceedings were very successful and highly appreciated by an attentive audience. It may be mentioned that the lecture was arranged by the Limehouse Scientific Society, a small body of energetic men.

NOTES.

NOTICE TO READERS.—Subscribers are hereby notified that in future the supply of back numbers of the ELECTRICAL REVIEW cannot be guaranteed by the publisher; it is therefore expedient that those who desire to complete their sets should do so at the first convenient opportunity. The publisher also desires to give notice that after December next all copies dated six or more months previously will be supplied only at enhanced prices, that is to say, 4d. numbers will be charged 6d., and others at similarly advanced rates.'

ELECTRIC LIGHTING.—A very large number of local authorities have applied for licences or provisional orders under the Electric Lighting Act, and it has been stated that in many cases the application is prompted, not so much by the desire of lighting their respective districts themselves, as of preventing the electric light companies from doing so; and it will be remembered that one of the leading rules of the Board of Trade, under section 5 of the Act (rule 2), is to the effect that local authorities are to have the preference in cases where "any other authority, company, or person" may compete with them for the grant of a provisional order. This preference, however, is restricted to the application, and when the application is once granted neither the Act nor any rule yet made provide for any particular privileges of a local authority in supplying the light, nor any exemption from the heavy burdens which may be imposed by the Board of Trade under section 6. This section provides that the undertakers shall be subject to such regulations and conditions as may be inserted in any licence or provisional order as to (*inter alia*) the compulsory supply of electricity, the securing a regular and efficient supply, the limitation of the price to be charged, and the enforcement of the due performance of the duties of the undertakers in relation to the supply of electricity by the imposition of penalties or otherwise. The corporations appear at last to have become alive to the awkward position in which they stand, and the deputation which waited on Mr. Chamberlain recently was the result. The deputation did not receive much consolation from their interview, and it is obvious that the corporations will have to consider carefully the course which they should take. We cannot find in the rules yet issued any provision for withdrawing an application, but we presume that this can be done by any applicant at any time; and perhaps, on considering the difficulties with which they will have to contend at the expense of their constituents, we may hear before long of pressure being put upon some local authorities to leave the field to be fought for by competing private companies. On the other hand, though the Act contains nothing to authorise, it seems to contain nothing to prevent, the Board of Trade from granting licences and orders with less onerous conditions to the local authorities than to the companies; but whether that board, which is almost all-powerful under the Act, will be inclined to do so, or whether it will consider that "special circumstances," within the meaning of rule 2, render the preference of the application of the local authority "inexpedient," are matters on which we forbear to speculate.—*Solicitors Journal.*

THE Stonelaw Skating Pond, Rutherglen, was the scene of considerable excitement on Saturday evening last, through the unexpected lighting of the pond by an arc lamp supplied by Mr. Akester, of the Bridgeton Universal Electric Company. The experiment was successful and the vivacity of the skaters unbounded.

THE Maxim-Weston Company have completed a large installation near Durham. Last week two contracts for installations in Scotland and Ireland were secured. The number of orders for their Weston arc lamps is such that they have had to increase their staff. The demand for the Maxim lamp is said to be steadily increasing.

PRINCIPAL VIRIAMU JONES, Firth College, Sheffield, delivered before a large audience in the Kinnaird College, Dundee, on Friday se'nnight, an interesting lecture on the electric light. The hall was lighted by electricity.

THE extensive railway carriage works of Messrs. Brown, Marshalls and Company (Limited), at Saltley, near Birmingham, extending over an area of 10 acres, are now lighted by electricity. The lighting is effected by means of 40 Brush arc lights of 2,000 candle-power each, driven by one of Fowler's 16 nominal horse-power semi-portable engines, the work having been carried out by the Birmingham and Warwickshire Brush Electric Light and Motive Power Company (Limited). The result is said to be very satisfactory both as regards efficiency and economy.

MR. N. STEVENSON, Manchester, uses a small Swan incandescent lamp to illuminate the cavity of the mouth in his dental operations. It is fitted into a vulcanite cup, which acts as a prop to keep the jaws apart.

THE Dunfermline Town Council have agreed to co-operate with other burghs throughout Scotland in a joint representation to the Board of Trade, or in such action as may be deemed advisable in relation to the Electric Lighting Act and the applications by private companies for Provisional Orders.

AT a meeting of the Montrose Police Commission on Monday, a motion was made that the Commission fix upon the Brush Electric Light Company to supply the town with the electric light. After an animated discussion, it was decided to consider the motion at next monthly meeting, and that prior to that day the board should meet in committee and consider the matter.

THE Stirling Police Commissioners have replied to a letter from the Brush Electric Light Company asking the same terms for supplying Stirling with electricity as had been granted for the burghs of Aberdeen and Dundee, that they are to take no action in regard to the electric light "at its present experimental stage."

WE have received from the Edison Electric Light Company information to the effect that during the recent extraordinary fog the company, recognising the necessity for distributing the light to their customers without intermission, maintained their dynamos in action at Holborn Viaduct for a continuous period of 64 hours without stopping. Starting at three o'clock on Saturday afternoon, December the 9th, the dynamos ran without ceasing during Saturday, Sunday, Monday, and Monday night, stopping at eight o'clock on Tuesday morning, December the 12th. This had not before been done in England, and was not accomplished by the other electric light companies in the city.

The current was supplied from two large dynamos which are used alternately, and during this long run the current was switched off from one dynamo on to the other, or back again five times by means of a peculiar switch which enables this to be done without in the least degree interrupting the lighting. The incandescent lamps in the shops on Holborn Viaduct and in the street were thus maintained during the whole of this time.

The company have, therefore, demonstrated not only their ability to supply electric lighting on a large scale as they have been doing for the past nine months, during the hours of usual darkness, but to maintain constant electrical pressure in the mains day and night and to comply completely with the condition of continuity of lighting, which is requisite in order that the problem of distributing electricity for lighting and other purposes may be considered solved.

IN Sheffield, the premises of Mr. Arthur Davy, provision merchant, are illuminated by 120 incandescence lamps. The arrangements have all been carried out by Messrs. Tasker, Sons & Co., with great success.

AN indignation meeting was held in Walworth (London) on Tuesday evening, the 5th inst., to protest against the determination of the Newington Vestry to undertake the supply of electricity. A long and animated discussion took place, and it was resolved that a committee be appointed to take the necessary steps for opposing the Vestry.

IN the Bermondsey Vestry the Clerk reported that the Metropolitan (Brush) Electric Light and Power Company had given notice of their intention to apply to the Board of Trade for a Provisional Order to authorise that company to light the district by electricity.

AT the meeting of the St. Olave's Board of Works the Electric Light Committee reported that the Metropolitan (Brush) Electric Light and Power Company had deposited plans for a Provisional Order to light the district of St. Olave's and the parishes of Bermondsey and Rotherhithe;

and they (the committee) recommended that delegates be invited from the other parishes to a conference, and that notice of opposition to the application be given. The recommendation was adopted on the motion of Mr. Scovell, who remarked that the committee did not wish to forestall the decision of the board, but merely wished to retain the option of opposing the application.

THE Canterbury Town Council met on Wednesday to consider the means to be adopted by them in connection with the application by three companies for Provisional Orders authorising them to establish works and lay down the necessary apparatus for supplying Canterbury with the electric light. The meeting declared itself to be unanimously in favour of the insertion of clauses for the protection of the interests of the city in the Provisional Order issued by the Board of Trade.

IN London a meeting of the Commissioners of Sewers has been called for Tuesday, January 9th, 1883, to consider the following motion by Mr. Moore, viz., "That the Remembrancer and solicitor be instructed to take the necessary steps to obtain a licence for electric lighting, in accordance with the resolution passed on October 24th last."

THE ELECTRIC LIGHTING OF THE BAZAAR OF THE BON MARCHÉ.—We know that the two largest novelty stores in Paris are the Louvre and Le Bon Marché. For a long time the first has been chiefly lighted by Jablochkoff candles, which made their first appearance there in 1877. The illumination is satisfactory, but it presents nevertheless certain inconveniences, such as, for example, the insufficient divisibility of the lights, which necessitates decreasing their lustre by enclosing them in ground-glass globes, which absorb a large portion of the light, and the hissing noise, due to the alternating currents, renders them sometimes troublesome. For an illumination *de luxe* these are rather important inconveniences. Taking this into consideration, the managers of the Bon Marché wished to do better. The progress made in the last few years in electric lighting made it easy to satisfy this desire, and their attention was, of course, turned to incandescence lighting, which, under favourable conditions for working, presents qualities exactly the opposite to the defects which we have just mentioned. The Edison system was chosen. The installation comprises about 480 lamps of the type A (16 candles), divided in nearly equal portions in the basement, used as workshops and domestic offices, and a portion of the ground-floor, consisting of the *magasins*.

These 480 lamps are supplied by two Edison machines of the type K, turning at 900 revolutions per minute, and calculated to supply 250 lamps each at the normal speed. One machine works in the daytime for the illumination of the basement, and in the evening both are put in action for lighting the *magasins*.

These two machines are actuated by a compound steam-engine, by Messrs. Weyher and Richemond, of sixty horse-power, but which is capable of working up to seventy.

In one part of the *magasins*, where the incandescent lamps have replaced—jet for jet—the gas burners, the illumination is very satisfactory as to quantity, but it still leaves much to be desired as regards quality. The lamps flicker, or to use a fanciful expression, respire, indicating by their variable lustre every phase of irregularity in the engine which actuates the generators. This defect is undoubtedly owing to the bad conditions of the provisional installation, to insufficiency of fly-wheel on the engine, and to too great a distance of the engine from the counter-shafting, which necessitates stretching the bands beyond measure, &c. There is fortunately a remedy for this evil, and in a few days this light will present all the steadiness and beauty which characterises lighting by incandescence; we shall then have no more to do than to offer congratulations to the Edison Company and to the managers of the Bon Marché.

CABLE NEWS.—The *Philadelphia Press* says:—The cable steamer, *Duchess of Marlborough*, is now in Colon, and is about to proceed to repair the cable thence to Jamaica, which is broken at a point about thirty miles from the port. The Central and South American Cable Company have determined to cut the T piece out of their line—the shank of which now gives us our connection with the system—and to bring the ends of the northern and southern cables into the City of Panama. This will much diminish the power required in transmitting.

The Admiralty charts of the Bay of Panama, as corrected up to 1865, are entirely incorrect in respect to many of the soundings given in them. Captains who endeavour to bring their vessels up the bay at night may find themselves out of their course, and, being unable by soundings to tell where they are, cannot reach the anchorage without waiting for daylight. It is believed the soundings taken by the officers of the s.s. *Silvertown* will add much valuable information on this subject, and enable some corrections to be made at once, since they not only sounded along the line occupied by the cable, but also straight across the bay from shore to shore, thus embracing an extensive area in which no soundings had ever previously been made.

THE NEW RED SEA CABLE.—We read in the *Journal Télégraphique de Berne* that the Berber-Kassala-Sourrakim telegraph line not yet being open to the transmission of messages written in European languages, the new cable laid between Sourrakim and Jiddah cannot yet be used for the general service of the international traffic. The Egyptian Telegraph Administration does all it can to be able to open as soon as possible to all correspondence the line from Berber to Sourrakim, but the present political situation of the country near the Soudan does not allow to foresee the time when this opening will take place.

UNDERGROUND TELEGRAPH LINES.—The first opening of the underground telegraph lines for public service says *La Lumière Electrique*, has taken place in Paris at the Ministry of Posts and Telegraphs. The telegraph lines opened to traffic are the Paris-Lille, Paris-Nancy, and Paris-Dijon lines. After these three named lines, the Paris-Lyon line will be opened.

MR. W. T. HENLEY.—It is with extreme regret we learn, as we go to press, of the death of this well-known electrician. The majority of our readers will be well acquainted with his career in connection with the Telegraph Works Company bearing his name.

TELEPHONIC COMMUNICATION.—On Monday the Glasgow Watching and Lighting Committee considered the desirability of establishing telephonic communication between the various municipal departments and the Telephone Exchange. They ultimately decided, after hearing reports, to make no change in existing arrangements.

SALE OF PATENTS.—It is said that the directors of the Electric News Telegraph Company (Limited), have arranged the sale of their American patents for a sum which will give a bonus of almost 100 per cent. to their shareholders.

ELECTROLIERS FOR THE ELECTRIC LIGHT, &C.—In the last number of the ELECTRICAL REVIEW we noted our visit to the firm of Messrs. B. Verity and Sons, of King Street, Covent Garden. On that occasion the members of the Board of Works for the Strand district inspected the Edison system of electric lighting. We have since had the opportunity of going over the whole of Messrs. Verity's workshops. It would occupy too much of our space to describe all the operations of this eminent firm of ornamental brass-workers for completing their admirable and innumerable designs. Their display at the last Electrical Exhibition (Crystal Palace) will be remembered by all who visited the Concert Hall, the Entertainment Court, with its floral basket supporting 99 Edison lamps, the show-rooms of the Domestic Electric Light Company, and other places. In connection with this subject we may add that Messrs. Verity do not exhibit at the present Gas and Electrical Exhibition. The Holborn Restaurant, which is being fitted up with Edison incandescence lamps, will soon contain some of the most beautiful and elaborate designs for electroliers ever seen, designed and constructed by Messrs. Verity. But far better than any remarks from us would be a personal visit to the show-rooms of the firm. The Edison system of electric lighting is shown from dusk till 7 p.m. in connection

with the firm's electric light fittings, to any one presenting a card with name and address. A chandelier with a patent ball and socket joint is worthy of note, as showing how it may be turned and twisted about without injuring the conducting wires.

BRITISH ELECTRIC LIGHT COMPANY, LIMITED.—The following are some of the works recently executed by this company or in hand: Manchester Royal Exchange. This handsome building was illuminated on the evening of the 1st December for the first time with 10 new automatic Brockie arc lights of 3,000 candle-power each (there will ultimately be 17 lamps) and 400 British incandescent lamps, of 15 candle-power each. The light attracted a great many sightseers and was universally admired. The United Steamship Company's steamer *Kjobenhavn*. This vessel has just been lighted with incandescent lamps, which have been tastefully arranged all over the ship, and fitted upon bronze-gilt brackets representing mermaids. The whole presents a very pretty effect, and the lighting, which has now been in operation for nearly two months, has given great satisfaction. The vessel has one arc light. There will probably be sixty more vessels of the same line to be lighted. The following contracts are not quite completed: Messrs. Walker & Son, Oil Mills, King's Lynn; special engine, Gramme machines, and 80 British incandescent lamps. The Civil Service Supply Association, Bedford Street; arc lights and Gramme machines. British India Steam Navigation Company's steamship *Dacca;* 108 British incandescent lamps, 2 arc lamps, and Gramme machines.

THE CRYSTAL PALACE GAS AND ELECTRIC EXHIBITION.—This exhibition was opened on Wednesday last, but we hear that the gas exhibits are more numerous and in a more forward state than those connected with electricity. We propose to treat on the exhibits from time to time.

NEW COMPANY REGISTERED.

CHARAKITE COMPANY (LIMITED).—Capital £8,000, in £5 shares. Objects: To carry out an agreement of 1st inst. between R. E. Goolden and George Adams for the purchase of an invention for an improved manufacture of insulated (?) compounds applicable also to other purposes. Signatories: J. Montgomery Walker, 9, Old Broad Street, 100 shares; J. M. Hyndman, 10, Devonshire Street, W.; C. S. Dawson, 40, Wigmore Street; R. G. Goolden, 8, Hanover Square; G. Adams, 16, Bishopsgate Street Within; L. Mayes, 188, Palmerston Buildings, E.C.; J. C. M'Laren, Oriental Club; one share each. The signatories are to appoint the first directors. Registered 12th inst. by Matthews and Greetham, 26, Bedford Row.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

NATIONAL TELEPHONE COMPANY (LIMITED). — The second annual return of this company, made up to the 1st of September, was filed on the 9th of September. The nominal capital is £600,000 divided into 15,000 preference shares of £10 each and 90,000 ordinary shares of £5 each. Upon each preference share £6 has been called up and the full amount upon each ordinary share. The calls paid amount to £539,618, leaving £11,502 unpaid. Registered office, 11, Queen Victoria Street.

SWAN'S ELECTRIC LIGHT COMPANY (LIMITED). — The second return of this company, made up to the 16th of May, was filed on 26th May. The nominal capital is £100,000, in £10 shares, the whole of which has been taken up. Upon each ordinary share £5 has been called, the shares allotted to the vendor being considered fully paid. The calls paid amount to £37,500 and considered as paid to £25,000. Registered office, 13, Mosley Street, Newcastle-on-Tyne.

PYRAMID ELECTRIC COMPANY (LIMITED).—The return of this company, made up to 11th ult., was filed on the 6th inst. The nominal capital is £80,000, in £1 shares. 2,530 shares have been taken up and 10/- per share called. The calls paid amount to £1,174 2s. 10d., leaving £290 unpaid. Registered office, Whitecroft, Forest of Dean, Gloucestershire.

NEW PATENTS—1882.

5833. "Incandescent electric lamps." J. WAVISH and J. WARNER. Dated December 6.

5850. "Electro-magnets (insulating)." V. W. BLANCHARD. Dated December 8. (*Complete.*)

5861. "Gaso-electric lamps." P. M. JUSTICE. (Communicated by J. H. Loder.) Dated December 8.

5866. "Electric commutators." J. GORDON. Dated December 8.

5870. "Increasing the efficiency of telephones." W. R. LAKE. (Communicated by A. E. Dolbear.) Dated December 8.

5887. "Voltaic batteries." L. HARTMANN. Dated December 9.

5899. "Apparatus for lighting, heating, and communicating by electricity, applicable in part to other purposes." P. R. ALLEN. Dated December 9.

5910. "Electric lamps." F. H. F. ENGEL. (Communicated by F. Kuppermann.) Dated December 11.

5918. "Dynamo-electric machines." H. H. LAKE. (Communicated by R. H. Mather.) Dated December 12.

5926. "Treating for heating and other purposes organic bodies by an improved electropathic method called the bisolenoïdal electropathic method, for the application of which improved bisolenoïdal instruments are employed." H. HANG and A. WIENAND. Dated December 12.

ABSTRACTS OF PUBLISHED SPECIFICATIONS. 1882.

1956. "Electric batteries." T. J. HANDFORD. (A communication from abroad by B. Jarriant, of Paris.) Dated April 25. 8d. Single liquid electric batteries working with bichromate of potash and injection of air, and which are known as "Grenet" batteries, are not capable of being employed for lighting purposes unless the currents generated are constant and economical, and means are provided for enabling a number of such batteries to be worked without inconvenience. The object of the invention is to enable—1st. The liquid in the battery to be automatically renewed in a constant and regular manner; 2nd. The liquid solution to be as inexpensive as possible, and the elements of the battery to be capable, after having served to generate an electric current of being regenerated or renovated, as well as the other substances which it contains; 3rd. The zinc plates constituting the negative poles of these batteries to remain well amalgamated until completely consumed or worn out; 4th. The carbon plates constituting the positive poles of these batteries to be provided with inoxidisable armatures, and the air blown against these plates to be sufficient to remove all the traces of oxide of chromium; 5th, lastly. When employed for lighting purposes with one or more lamps the batteries to be capable of being controlled or worked with facility, and be brought into action and thrown out of action automatically by locking and unlocking devices operated by electricity.

1999. "Accumulating and storing electric currents, &c." J. B. ROGERS. Dated April 27. 6d. The object of this invention is improved means of accumulating and storing electric currents, and in economically utilising the energy so stored for lighting purposes. According to this invention, the inventor uses small or comparatively small receivers or secondary batteries, within which the current or currents from dynamo machines or other electric force producers is or are taken up and stored as intensity currents, to be used for all lighting purposes in which intensity is desired. Coupled to these small receivers are one or a series of larger receivers of the same or of a different kind which receive the energy or force from the smaller ones. The current in the large receiver or receivers can be stored in quantity to be used as desired for more evenly dividing the flow to the lamps than can be obtained from one sized secondary battery or batteries alone. By the invention, *i.e.*, through larger receivers being supplied from smaller ones, the light is maintained for a much longer period after the dynamo has ceased to work, than by any known system ! ! ! ! ! !

2020. "Obtaining electric light." J. C. ASTEN. Dated April 28. 2d. This invention consists in making the outer or positive carbon or pole of a hollow form, tubular or otherwise, in the interior of which the negative carbon or pole is inserted. The superficial area of the positive pole is greater than that of the negative pole. A nonconductor consisting either of clays or vitrifiable or other suitable materials is placed between the two carbon poles. Another part of the invention consists in surrounding the negative pole with a nonconductor composed as above-mentioned, and placing adjacent to it two or more positive carbon poles. The negative pole may be made of a hollow form tubular or otherwise, and this hollow space may be either left empty or be filled with a material which may either be a conductor or a nonconductor of the materials as above-mentioned. The two poles may be connected by a material suitable for that purpose as is now usual. (*Provisional only.*)

2030. "Electrical switches or changers." The Honourable R. BROUGHAM. Dated April 28. 6d. Has for its object improvements in electrical switches or circuit changers.

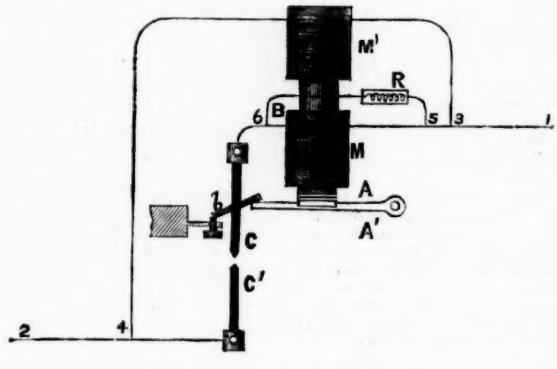
2044. "Dynamo-electrical machines." Honourable R. BROUGHAM. Dated April 29. 6d. Has for its object improvements in dynamo-electrical-machines, and the improvements relate to that class of continuous current dynamo electrical machines in which a cylindrical ring of iron (embraced by a series of coils of an insulated copper conductor ranged in planes parallel with the axis of the ring) is caused to revolve with its circumference in close proximity to the poles of electro-magnets. Usually, as in the well-known Gramme machines, the cylindrical ring of iron has been wound with a series of coils of insulated conducting wire, each made up of numerous turns of insulated wire either circular or flattened, lying side by side and one over the other—and the inner end of each coil and the outer end of the succeeding coil have been coupled by radial strips to insulated metallic bars or plates ranged lengthwise along the axis by which the cylindrical ring is carried. The electric current generated has been carried off from these bars by metallic conductors bearing against the opposite points of the axis. According to this invention in place of constructing the revolving ring of continuous current dynamo machines in this manner the inventor forms each insulated conducting coil by which the ring is embraced of a strip of copper of a width equal to the width of the coil to be formed. The strip before being wound into a coil around the ring is braided or covered over with strands of cotton or other fibre, or is otherwise insulated.

2052. "Electrical generators and engines, &c." T. J. HANDFORD. (A communication from abroad by T. A. Edison.) Dated May 1. 6d. Relates to dynamo or magneto-electric machines, or electric engines, and to apparatus or means for regulating the generative capacity of dynamo or magneto-electric machines. The object of the first part of the invention is to produce a dynamo or magneto-electric machine or electric engine, which will possess the features of exceedingly low resistance, and great strength, compactness, and economy. This is accomplished by the use of a number of discs (preferably of copper) for the bobbin or winding of the armature, which discs are connected to develop (when the machine is used as a generator) a continuous current of electricity having a tension due to the electromotive force of a number of discs.

2065. "Microphonic conductors or contacts, &c." J. H. JOHNSON. (A communication from abroad by Doctor Arsène D'Arsonval, of Paris.) Dated May 2. 2d. Relates to the preparation of substances which possess the necessary properties for forming efficient microphonic conductors or contacts, and to their application for this purpose. A metallic sulphide, such as sulphide of iron, copper, lead or silver, for example, with or without an excess of metal, is melted in a crucible; in certain cases a metallic oxide is added, or a mixture of sulphides of different metals is prepared. These sulphides when melted may be employed either alone or as the cover or coating of a metal which affords them support, either by dipping the metal into the molten sulphide, for example, or by superficially sulphurising the metal itself by exposing it to be acted upon directly by sulphur in a fused or gaseous condition, or by any known chemical process of sulphurisation. (*Provisional only.*)

2068. "Secondary battery." C. H. CATHCART. Dated May 2. 4d. A plate of lead is coated with oxide of lead either chemically or mechanically, and is wrapped in some suitable material, such as flannel, to prevent the oxide from falling off the plate. This constitutes a negative plate. A plate of zinc is coated electrolytically with deposited zinc, and well amalgamated; this constitutes the positive plate. If desired, two of these zinc plates may be used with each negative plate. The above-mentioned positive and negative plates are placed in a vessel containing a strong solution of zinc sulphate acidulated with sulphuric acid, to which other similar salts, such as sulphate of magnesium, may be added if found desirable.

2072. "Electric lights." T. J. HANDFORD. (A communication from abroad by T. A. Edison.) Dated May 2. 6d. Relates to the description of electric lights which are known as arc lights and in particular to the regulating mechanism of the same. One part of the said invention relates to the combination in regulating mechanism of two opposing electro-magnets or solenoids of the same or approximately the same resistance but of different weights (that is to say having different weights of metal in their coils) located one in the main line and the other in a shunt around the arc and of a shunt circuit formed around the electro-magnet or solenoid in the main line. This part of the said invention is illustrated by the figure. M and M¹ are two electro-magnets (or they may be solenoids) of the same or approximately the same resistance. The former is located in the line 1, 2, in which are also the carbon electrodes, C C¹, of the lamp, and the latter is located in a shunt circuit, 3, 4, which is formed around the arc or the carbon electrodes. A shunt circuit, 5, 6, with a small resistance, R, is formed around the electro-magnet or solenoid, M, such circuit being joined to the line immediately on opposite sides of the connection of M therewith. The electro-magnet (or solenoid, M, while of the same resistance as M¹, has a greater weight of copper in its coils. When M and M¹ are electro-magnets, as in the example illustrated, they act oppositely upon a stationary core, D. The armature, A, is carried by a lever, A¹, which works a gripping eye, *b*, or other suitable device for lifting the upper or positive carbon electrode, *c*, to form an arc and for regulating the feed of such carbon electrode. When M and M¹ are solenoids they may act upon the same movable core which can be connected directly with the lever or arm that works the gripping eye. When C and C¹ are in contact M predominates and lifts C, so as to form the arc. When the arc increases to a definite degree, M¹ counteracts the sustaining effect of M and C is allowed to drop until again arrested by M. The low resistance shunt circuit, 5, 6, reduces the resistance of the main line and allows the current to flow freely to the lamps.



2107 "Electric safety apparatus for theatres, warehouses, &c." P. JENSEN. (A communication from abroad by R. J. L. Haviland, of Vienna.) Dated May 4. 6d. This invention consists in an arrangement of apparatus for automatically or at will and by electrical means to cause a stream of water to be thrown into any part of a theatre, warehouse, or other structure in case of a fire breaking out therein, and to cause doors, trapdoors, shutters, and other closing appliances to be opened and the curtain to drop.

QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid	Closing Quotations. Dec. 13.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	4	7½- 8	7¼ m. 7⅛.⅜ ⅛ ac.
		Do. Do.	10	15 - 18	15m. 16½.15½ .16½ ac.
30,000	5	Australasian Electric Light, Power & Storage Co.	3	½- 1	
24,900	10	British Insulite Co., Limited, "A" Shares	5	4 - 5	
30,000	5	Brush Electric Light & Power Co. (Scotland)	2½	½- 1	
25,000	5	Great Western Electric Light & Power Co.	2½	½- ¾	
24,930	5	Hammond Electric Light & Power Supply Co.	2½	4 - 4½	4.4⅛.4⅛.ac.
40,000	5	Indian & Oriental Electrical Storage Works Co.	2	¾- 1½	
172,500	1	Maxim-Weston Electric Light and Power Co.	1	⅜- ⅝	7/16 m.
40,000	5	Pilsen-Joel & General Electric Light Co.	2	1 - 1½	
..	..	South African Brush Electric Light & Power Co.	2½	½- 1½	
100,000	5	Swan United Electric Light Co., Limited	2	1½- 2½	
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	47½- 48½	47½ ac.
2,441,800*l.*	Stk.	Do. Preferred } Def'd. receiving no div. until }	100	78½- 79½	78½.9.8½ ac
2,441,800*l.*	Stk.	Do. Deferred } 6 p. c. has been paid to Pref. }	100	17½- 18½	
130,000	10	Brazilian Submarine, Limited	10	11½- 12	
16,000	10	Cuba, Limited	10	9½- 10	
6,000	10	Do. 10 per cent. Preference	10	16 - 17	
13,000	10	Direct Spanish, Limited	9	6½- 7	
6,000	10	Do. 10 per cent. Preference	10	16 - 17	
65,000	20	Direct United States Cable, Limited, 1877	20	11½- 11⅝	
100,000*l.*	100	Do. 6 per cent. Debenture, repayable 1884	100	100 -103	
330,000	10	Eastern, Limited	10	10⅞-11⅛	11 m.
70,000	10	Do. 6 per cent. Preference	10	13½- 13¾	
232,000*l.*	100	Do. 6 do. Debentures, repayable Oct. 1883	100	100 -103	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	101 -104	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	103 -106	
199,750	19	Eastern Extension, Australasia & China, Limited	10	11¾- 12½	11¹³/₁₆ ac.
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	100	108 -111	
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	105 -108	
140,000	100	Do. do. registered, repayable 1900	100	105 -108	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	101 -104	
254,300*l.*	100	Eastern and South African Limited 5 per cent. Mort. Deb. Registered redeemable 1 Jan 1900	100	102 -105	
345,700*l.*	100	Do. do. To Bearer	100	102 -105	
22,050	10	German Union Telegraph and Trust, Limite	10	10 - 10½	
163,390	10	Globe Telegraph and Trust, Limited	10	6⅞- 6¾	6⅞ m. 6⅞. ⅛ ac.
163,209	10	Do. 6 per cent. Preference	10	12⅜- 12⅞	
125,000	10	Great Northern	10	12½-12⅝	12½ m. 12⅝ ac.
100,000*l.*	100	Do. 5 per cent. Debentures	100	100 -103	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	28½- 29½	
100,000	100	Do. 6 per cent. Debentures, 1886	100	100 -103	
17,000	25	Indo-European, Limited	25	31 - 32	
38,148	10	London Platino-Brazilian, Limited	10	4½- 4¾	
12,000	10	Mediterranean Extension, Limited	10	1½- 2	
8,200	10	Do. 8 per cent. Preference	10	6 - 8	
9,000	8	Reuter's, Limited	8	12½- 12¾	
230,000	Stk.	Submarine	100	250 -255	
58,225	1	Do. Scrip	1	2⅛- 2⅜	
4,200	Cert.	Submarine Cables Trust	100	104 -108	
37,350	12	Telegraph Construction and Maintenance	12	32 - 33	
150,000	100	Do. 6 per cent. Bonds, 1884	100	102 -105	
186,750	5	Do. 2nd Bonus Trust Cert.	5	1⅜- 1⅝	
30,000	10	West Coast of America, Limited	10	5 - 5½	
150,000	100	Do. 8 per cent. Debentures	..	.. ..	
69,910	20	Western and Brazilian, Limited	20	7⅜- 7½	
200,000*l.*	100	Do. 6 per cent. Debentures "A" 1910	100	104 -107	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80. red. Feb., 1910	100	95 - 99	
1,500	$1,000	Western Union of U. S. 7 p.c.1 Mort.(Building) Bds.	$1,000	122 -126	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	102 -105	
88,321	10	West India and Panama, Limited	10	1¼- 1⅜	
34,563	10	Do. 6 per cent. 1st Preference	10	7 - 7½	
4,669	10	Do. 6 do. 2nd do.	10	5½- 6	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. 1 to 154,165	1	⅝- ¾	⅝ ac.
200,000	1	Oriental Telephone Co., Nos. 100,000 to 300,000	½	⅝- ¾	
100,000	5	United Telephone Co.	5	10½- 11	